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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-29177# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).

ON THE APPLICABILITY OF WATER ANALOGY TO INVESTIGATIONS ON AERODYNAMIC DECELERATION DEVICES [UBER DIE ANWENDBARKEIT DER WASSERANALOGIE AUF UNTERSUCHUNGEN AN AERODYNAMISCHEN VERZOGERUNGSGERATEN]

G. Niehus 21 Dec. 1964 28 p refs In GERMAN; ENGLISH summary Presented at the Joint Annual Conv. of WGLR and DGRR, Berlin, 14–18 Sep. 1964

(DLR-FB-64-46) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 7 DM

Theoretical and experimental investigations on aerodynamic deceleration devices for the recovering of spacecraft are difficult, because these devices have to function in speed and density ranges with strong alteration of air flow conditions. In order to survey problems and to come to some quantitative statements, generally, the methods of water analogy are applied. For a description of the advantages of water analogy and the boundaries of applicability, the theoretical principles and experimental methods are discussed. Air flow and shallow water flow around bodies which are of interest with respect to deceleration techniques are compared. Experimentally and theoretically determined flow patterns and pressure distributions are shown. Author

N65-29180# Rice Univ., Houston, Tex.

EXTREMAL PROBLEMS IN AERODYNAMICS

Angelo Miele 1965 36 p refs Presented at the Symp. on the Math. Theory of Optimal Control, Ann Arbor, Mich., 5–7 Oct. 1964 *Its* Aero-Astronautics Report No. 1

(Grant AF-AFOSR-828-65)

Physical models of interest in the theory of optimum aerodynamic shapes are reviewed. Corresponding mathematical models are illustrated for problems involving one and two independent variables. New trends in the theory of optimum aerodynamic shapes as well as certain problems in the immediate future are outlined. R.N.A.

N65-29196# ARO, Inc., Arnold Air Force Station, Tenn.

DYNAMIC STABILITY CHARACTERISTICS OF A 10-DEG CONE AT MACH NUMBER 20

R. H. Urban and R. J. Shanahan (Aerospace Res. Labs.) Arnold Eng. Develop. Center, Apr. 1965 21 p refs

(Contract AF 40(600)-1000)

(AEDC-TR-65-80; AD-461260)

Tests were conducted in the 30-Inch Hypersonic Tunnel on the Aerospace Research Laboratories, Wright-Patterson Air Force Base, Ohio to determine the effects of Reynolds number and frequency of oscillation on the damping-in-pitch derivatives of a 10-deg half-angle cone. Free oscillation data were obtained at a nominal Mach number of 20, at Reynolds numbers, based on model base diameter, from 50,000 to 100,000, and at model oscillation frequencies from 8 to 45 cps. Test results are presented, and comparisons are made with modified Newtonian impact theory and an unsteady flow field theory. Author

N65-29224*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A GENERALIZED APPROACH TO DYNAMIC-STABILITY FLIGHT ANALYSIS

Peter Jaffe 1 Jul. 1965 15 p refs

(Contract NAS7-100)

(NASA-CR-63945; JPL-TR-32-757) CFSTI: HC $1.00/MF $0.50 CSCL 01A

A general approach to the analysis of planar flight dynamic-stability investigations is presented and examples are used to discuss the approach. The foundation of the approach is the energy-integral equation which relates the energy defect during a half cycle, due to the decay, to those factors causing the decay. The equation can accommodate nonlinear aerodynamics, large oscillatory amplitudes, nonsymmetric or lifting bodies, and noncontinuous or double-valued aerodynamic coefficients. Examples are presented demonstrating these applications. In addition, this report also suggests that the usual closed-form differential solution may not be properly representing all physical mechanisms producing decay because of the continuous nature of its formulation. Author

N65-29229# Aeronautical Research Labs., Melbourne (Australia).

LOW SPEED WIND TUNNEL EXPERIMENTS ON THICK HIGH LIFT AEROFOILS EMPLOYING BOUNDARY LAYER CONTROL BY BLOWING

N. J. Munro Sep. 1964 81 p refs

(ARL/A-229)

A series of thick blowing aerofoils was developed and tested individually in a 9' × 7' low speed wind tunnel in connection with the wing tip extension scheme. On the basis of measured pressure distributions, the lift appeared to be increased by the addition of a bump to the profile behind the blowing slot. Lift and drag forces were measured for two bumped aerofoil sections; the pitching moment was also measured for the preferred section (Section 3). Typical lift and drag coefficients for this section at RN = 214,000, incidence $\alpha = 20°$ and blowing momentum coefficient $C_\mu = 0.4$ are $C_L = 6.3$ and $C_D = 0.73$. The pitching moment coefficient changes linearly with C_L. Author

N65-29287# Weapons Research Establishment (Australia). Dept. of Supply.

FLOW OVER THE SUCTION SURFACE OF SHARP EDGE DELTA WINGS WITH DETACHED LEADING EDGE SHOCK WAVES

J. A. Rein Dec. 1964 34 p refs

(HSA-102)

Results are presented which show that rolled up vortex sheets occur near the apex on the suction surface of sharp edge delta wings with detached leading edge shock waves. Further back there can be large areas of attached flow, their form depending on wing geometry, incidence and Mach number. An approximate theoretical model is presented to explain the inviscid flow behaviour and the modifications to be expected as a result of viscosity. It is believed that the flow patterns obtained are Reynolds number dependent and that wind tunnel results should be examined with caution. Author

N65-29295*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

COMPUTER PROGRAM FOR CALCULATING FLOW FIELDS IN SUPERSONIC INLETS

Virginia L. Sorensen Washington, NASA, Jul. 1965 133 p refs

(NASA-TN-D-2897) CFSTI: HC $4.00/MF $1.00 CSCL 01A

A Fortran IV computer program for calculating the flow fields in three-dimensional axisymmetric or two-dimensional inlets has been written. The program has been written to handle inlets designed with smooth compression surfaces and for which the attached bow shock falls outside the cowl lip. The method of characteristics has been used to calculate a uniform field of points and at each of these points the total pressure, Mach number, local flow angle, and static pressure ratio are printed. The numerical procedures used are fully described and a test case is presented. Author

N65-29383*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EXPERIMENTAL DETERMINATION OF NONLINEAR ROTARY STABILITY DERIVATIVES

Murray Tobak [1964] 8 p ref Presented at 22nd Semi-ann. Meeting of the Supersonic Tunnel Assoc., Brussels, 24–25 Sep. 1964

(NASA-TM-X-51995) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Before the results of an aerodynamic experiment can be freed from the method used to determine them, the true form of the equation governing the motion must be established. This form, will, of course, depend on the form of the aerodynamic forces and moments. The problem is, therefore, to write the aerodynamic forces and moments in a form which is sufficiently general to apply to any of a wide variety of possible motions. In the linear case, one achieves this by writing the forces and moments as a sum of terms involving stability derivatives. This paper is especially concerned with the question as to whether stability derivatives exist in the nonlinear case. An equation is presented which represents the general form for the aerodynamic pitching moment. This equation is the desired general form which should underlie all special cases and apply to all particular motions. This form is applied in a particular case and a correlation is made of the experimental results. N.E.A.

N65-29413*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

FREE-FLIGHT CONE DYNAMIC STABILITY TESTING AT HIGH AMPLITUDES OF OSCILLATION

Bain Dayman, Jr. [1964] 16 p refs Presented at the 22d Semi-annual STA Meeting, Brussels, Sep. 1964 Submitted for Publication

(Contract NAS7-100)

(NASA-CR-64082) CFSTI: HC $1.00/MF $0.50 CSCL 01A

This paper presents a summary of information from several published reports and tests recently completed which deal with the measurement of dynamic stability of cones at high amplitudes of oscillation by use of wind tunnel free-flight techniques. The techniques of testing and data reduction are very briefly mentioned as they have been described in adequate detail elsewhere. However, considerable damping data are included in order to fully document the value and consistency of the results. Author

N65-29440*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WING SWEEP AND BLUNTING EFFECTS ON DELTA PLANFORMS AT M = 20

Robert D. Witcofski and Don C. Marcum, Jr. [1965] 13 p refs Submitted for Publication

(NASA-TM-X-54706) CFSTI: HC $1.00/MF $0.50 CSCL 01A

This paper is a brief resume of the preliminary results obtained from an investigation recently conducted at Mach number of 20 in helium flow to determine the effects of leading edge blunting and sweep angle on the static longitudinal stability characteristics of basic delta planforms, with particular emphasis on the maximum lift–drag ratio. Only summary plots are presented. N.E.A.

N65-29482*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

STRESS AND SHAPE ANALYSIS OF A PARAGLIDER WING

Robert W. Fralich [1964] 43 p refs Presented at ASME Winter Ann. Meeting, New York, 29 Nov.–4 Dec. 1964

(NASA-TM-C-51958) CFSTI: HC $2.00/MF $0.50 CSCL 01A

A combined aerodynamic-structural analysis is made which is based on the assumption that the sail is flexible and has freedom to take the shape which the aerodynamic pressure and the internal stresses dictate. Numerical results were obtained for Newtonian impact aerodynamic theory and were compared with published results obtained for a rigid idealization of the paraglider wing. It was found that the assumed rigid idealization did not approximate the shape of a flexible wing well and led to significant errors in the lift and drag forces and the lift-to-drag ratio. The new calculations provide a basis for design of paragliders for hypersonic flight. Author

N65-29512# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AEROHYDROMECHANIC THEORY OF WING IN A NONSTATIONARY FLOW Selected Parts

A. I. Nekrasov 13 Jan. 1965 17 p Transl. into ENGLISH from Teor. i Prikl. Mekhan., Sb. Statey (USSR), v. 2, 1962 p 100-101, 611–622

(FTD-TT-64-777/1+2; AD-610791)

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2. THEORY OF AN ARRANGEMENT TO REDUCE PARACHUTE LANDING SPEED p 3–14 (See N65-29513 18-01)

N65-29513 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORY OF AN ARRANGEMENT TO REDUCE PARACHUTE LANDING SPEED

In its Aerohydromech. Theory of Wing in a Nonstationary Flow 13 Jan. 1965 p 3–14 (See N65-29512 18-01)

This report offers a mathematical theory of an arrangement, proposed for reducing the rate of landing of parachute loads. A model is prepared which confirms the reasoning used in the arrangement. Mathematically the theory offers the possibility of establishing an analytical dependence for elements, characterizing the movement of parachute and load, containing the arrangement. N.E.A.

N65-29606# Royal Aircraft Establishment, Farnborough (England).

OSCILLATING SLENDER WINGS IN THE PRESENCE OF LEADING-EDGE SEPARATION

D. G. Randall London, Min. of Aviation, Apr. 1963 42 p refs (RAE-Struct-286)

A study is made of the aerodynamics of wings executing simple harmonic oscillations. The wings considered are infinitesimally thin and slender; they may have longitudinal camber and curved leading edges. Leading-edge separation is simulated by an isolated line singularity of vortex type. The value of the reduced frequency is assumed to be such that Laplace's two-dimensional equation may be used as the governing partial differential equation. The determination of the flow then reduces to the solution of a simple problem in incompressible two-dimensional flow. The strength and position of the vortex and the generalized forces can be determined for an arbitrary wing by use of a Mercury Autocode programme. The modes of oscillation are assumed to be longitudinal, although both rigid-body modes and modes of deformation can be calculated. Results have been obtained for a cambered delta wing, a flat ogee wing, and a flat gothic wing; the results for the last wing are in fair agreement with experiment. Author

N65-29628# Royal Aircraft Establishment, Farnborough (England).

AN ESTIMATE OF THE LATERAL FORCES AND MOMENTS OF YAWED CARET WINGS

J. A. Bagley London, Min. of Aviation, Apr. 1962 24 p refs (RAE-TN-AERO-2813)

The flow pattern about a yawed caret wing is assumed to include two plane shocks, one attached to each leading edge, and the pressures on the lower surface of the wing panels are calculated assuming no interference between the two shocks. It is found that this simplified flow pattern is only possible for small yaw angles, but an estimate of the side-forces is obtained for several wings, including those proposed for a forthcoming test series. Author

N65-29632# Royal Aircraft Establishment, Bedford (England).

PRESSURE DISTRIBUTIONS AT M = 4.0 ON SOME "FLAT" DELTA WINGS

L. C. Squire London, Min. of Aviation, Feb. 1963 29 p refs (RAE-TN-AERO-2865)

Results are given of wind tunnel tests made to measure pressure distributions at M = 4.0 on two conical models with triangular cross-sections. The pressures on the flat faces of these models are discussed and compared with results on symmetrical wings of the same aspect ratio. Author

N65-29633# Royal Aircraft Establishment, Bedford (England).

SOME SUPERSONIC WIND TUNNEL TESTS ON THE FIXING OF BOUNDARY-LAYER TRANSITION USING DISTRIBUTED ROUGHNESS BANDS

T. A. Cook London, Min. of Aviation, Jul. 1961 20 p refs (RAE-TN-AERO-2772)

Some brief tests have been made to investigate the size of distributed roughness particles required to fix transition on the wings of a swept-wing model in the 8 ft × 8 ft supersonic wind tunnel at R.A.E., Bedford. Three sizes of roughness particles were tested at Mach numbers between 1.4 and 2.0 and over a Reynolds number range from 2.0×10^6 to 5.4×10^6, based on aerodynamic mean chord. The results show the effects on lift, drag and pitching moment of transition position and Reynolds number. The effects of too large a roughness size appeared to be small. Author

N65-29639# Royal Aircraft Establishment, Farnborough (England).

CALCULATION OF THE FLOW PAST SLENDER DELTA WINGS WIH LEADING EDGE SEPARATION

K. W. Mangler and J. H. B. Smith May 1957 52 p refs (RAE-AERO-2593)

The flow past a slender delta wing with a sharp leading edge, at incidence, usually separates along this edge, i.e. a vortex layer extends from the edge and rolls up to form a "core" (a region of high vorticity). A potential flow model of this is constructed in which the layer is replaced by a vortex sheet which is rolled up into a spiral in the region of the "core". This problem is reduced to a two-dimensional one by assuming a conical field and using slender wing theory. The shape and strength of the sheet are determined by the two conditions that it is a stream surface and sustains no pressure difference. Use is made of results previously obtained for the core region and the remaining finite part of the sheet is dealt with by choosing certain functions for its shape and strength. The parameters in these functions are found by satisfying the two conditions stated above at isolated points. Results are obtained for the pressure distribution, chord loading and normal force coefficient as functions of the ratio of the incidence to the apex angle. The lift for a given incidence is about 15% below that found by Brown and Michael. Flow patterns are indicated in two typical cases. The effect of separation on the drag due to lift of a wing with small thickness is discussed. Author

N65-29640# Royal Aircraft Establishment, Farnborough (England).

COMMENTS ON SOME RECENT BASIC RESEARCH ON V/STOL AERODYNAMICS

John Williams London, Min. of Aviation, Nov. 1961 21 p refs (RAE-TN-AERO-2795)

This Note mainly supplements an earlier paper on the basic aerodynamic aspects of V/STOL systems. Comments are made about recent aerodynamic research at the R.A.E., with particular reference to direct jet lift, propeller lift, jet flaps, and boundary-layer control. Author

N65-29663# Aircraft Research Association, Ltd., Bedford (England).

TURBULENT SKIN FRICTION ON A FLAT PLATE SUPERSONIC DELTA WING AT INCIDENCE

Ngo Duc-Lam Jun. 1965 14 p* refs Transl. into ENGLISH from Rech. Aerospatiale (Paris), no. 102, 1964 (ARA-LIB-TRANS-10)

The pattern of the three-dimensional turbulent boundary-layer flow over a delta wing at incidence is considered. Assuming the independence resulting from the hypothesis of small cross-flows, a simple model of turbulent boundary layer flow is proposed, and an approximate method of calculation of the skin friction on the lower side of the skin friction on the lower side of the wing is developed, based on the solution of the momentum integral equation. An expression is obtained for a factor representing the three-dimensional effects on the

mean friction coefficient, and depending on the sweep angle, the incidence and the Mach number. Numerical results are presented for various supersonic Mach numbers and a few values of incidence and sweep angles. Author

N65-29710# Royal Aircraft Establishment, Farnborough (England).
RE-ATTACHMENT OF AN AXI-SYMMETRIC SUPERSONIC JET ON THE WALL OF A CO-AXIAL CYLINDER [RECOLLEMENT D'UN JET SUPERSONIQUE DE REVOLUTION SUR UNE PAROI CYLINDRIQUE COAXIALE]
J. Délery Jun. 1965 15 p Transl. into ENGLISH from Rech. Aerospatiale (France), no. 104, Jan./Feb. 1965 p 15–20
(RAE-LIB-TRANS-1110)

The study of the re-attachment of an axi-symmetric supersonic jet on the wall of a co-axial cylinder has given, in the absence of the initial boundary-layer, a re-attachment angular law which, when substituted for the Chapman-Korst criterion, allows a correct quantitative prediction of base pressure. A study of the mass injection effect in a dead water region has shown how important the initial boundary-layer and the momentum injection effects are; it has also fully justified using in the calculation a generalized injection coefficient taking account of the secondary effects very accurately as long as these effects are moderate enough to be considered as a mass injection effect. Author

N65-29844*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL PRESSURE MEASUREMENTS IN THE WAKE OF A CONE-CYLINDER MODEL AT MACH NUMBERS OF 2.30 AND 4.65
John T. Mc Shera, Jr. Washington, NASA, Aug. 1965 12 p refs
(NASA-TN-D-2928) CFSTI: HC $1.00/MF $0.50 CSCL 01A

An investigation of the flow field behind a simple cone-cylinder body of revolution has been conducted at Mach numbers of 2.30 and 4.65. The results include local total- and static-pressure measurements in the wake. The results of the pressure distributions indicated that the use of thin struts to mount the wind-tunnel model had little or no effect on the wake characteristics behind the model. The distribution of total pressure in the wake throat region behind the model was extremely nonuniform and such characteristics would exert an unstable influence on a decelerator in the flow field. The total pressure loss near the center line in the wake of the model significantly increased with an increase in Mach number. Author

N65-29861# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Full Scale Div.
COMPUTER PROGRAM FOR COMPUTING TRIM CONDITIONS AND A RESPONSE TIME HISTORY TO A GIVEN INPUT FOR 3-DEGREE OF FREEDOM LONGITUDINAL EQUATIONS OF MOTION (NONLINEAR)
Clarence L. Mesiah and Francis E. Pritchard 14 Sep. 1964 22 p refs
(FDM-354)

A program, written for the IBM 7044 to solve the three-degree-of-freedom nonlinear longitudinal equations of motion, is presented. The main portion consists of the equations of motion for an airplane, and of digital schemes for computing the trim condition of the airplane and for integrating the equations of motion. Two subroutines are used to compute the forces and moments acting on the airplane due to aerodynamics and thrust. A third subroutine, considered a spare, is programed to give zero-valued outputs. The program's capabilities, limitations, and use are also discussed. C.T.C.

N65-29907# David Taylor Model Basin, Washington, D. C.
SHROUDED PROPELLER TESTS OF THE EFFECT OF SHROUD CAMBER ON THE THRUST COEFFICIENT FOR MINIMUM SHROUD DRAG
Arthur E. Johnson Apr. 1965 19 p refs
(DTMB-2005; DTMB-AERO-1090; AD-465895)

A wind-tunnel investigation of a powered, shrouded propeller with a related series of positively cambered shrouds has been made in order to determine the effect of shroud camber on the thrust coefficient that yields minimum shroud drag coefficient. Experimental measurements agree reasonably well with theoretical predictions, but are generally somewhat higher than the predicted results. Author

N65-29908# Northrop Corp., Hawthorne, Calif. Norair Div.
SUBSONIC LIFTING SURFACE DESIGN AND ANALYSIS PROCEDURE Final Technical Engineering Report
J. R. Stevens and J. W. Mc Donald Apr. 1965 257 p refs
(Contract NOw-63-0726-c)
(NOR-64-195; AD-466892)

This report presents the results of a study in which linearized lifting surface theory, relating wing mean line contours to pressure loading distributions on wings, was applied to the design and analysis of lifting surfaces at high lift coefficients in steady subsonic flow. Computer programs were developed to determine the aerodynamic characteristics and loading distributions on wings with arbitrary planforms and camber and twist distributions, and with constant per cent chord flaps. Programs were also developed to design camber and twist distributions on arbitrary planforms for either specified loading distributions or specified lift and moment coefficients with minimum induced drag. In the latter case, the loading distribution which is referred to as optimized is also calculated. Example theoretical predictions were compared with NACA test data and the results are presented. These comparisons include consideration of the effect of pressure distribution on separation and stall, and estimated maximum lift coefficients. Author

N65-29953*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
USE OF A SINGLE TURNING VANE TO ELIMINATE FLOW SEPARATION IN A SPACE-LIMITED 90° INTAKE ELBOW OF AN AXIAL-FLOW COMPRESSOR
S. Z. Pinckney Washington, NASA, Aug. 1965 30 p refs
(NASA-TM-X-1110) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The performance of a 90° inlet elbow of an axial-flow compressor was determined for the purpose of improving the elbow exit-flow distribution. The flow passage through the elbow changed from circular at the inlet to annular at the exit because a rotor-bearing housing was located in the center of the elbow. The elbow design was severely limited relative to optimum proportions. Exit total-pressure surveys of the original elbow design revealed regions of low velocity on the inner part of the elbow. The addition of a single vane greatly reduced the extent of low-energy regions. Author

N65-29962*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A TRANSONIC INVESTIGATION OF BASE PRESSURES ASSOCIATED WITH SHALLOW THREE-DIMENSIONAL REARWARD-FACING STEPS
Thomas C. Kelly Washington, NASA, Aug. 1965 49 p refs
(NASA-TN-D-2927) CFSTI: HC $2.00/MF $0.50 CSCL 01A

Results have been obtained with show effects on rearward-facing-step base pressures of variations in step height for

simulated launch-vehicle configurations where the steps were located both close to and considerably downstream of the nose-cone–cylinder junctures. The investigation was conducted over a Mach number range from 0.40 to 1.20 at an angle of attack of 0°. The results indicated that, for a typical launch-vehicle model used to simulate the case where the step was located at a considerable distance downstream of the nose-cone–cylinder juncture, step base pressure coefficients were found to be relatively insensitive to variations in Reynolds number. Slight effects of Reynolds number were noted, however, both in the cylinder surface pressure coefficients preceding a step and in the step base pressure coefficients for a configuration simulating the case where the step was located close to the nose-cone–cylinder juncture. Generally, the variation of step base pressure coefficient with variation in step height was relatively gradual for all configurations. Author

N65-29965*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

NEWTONIAN AERODYNAMIC CHARACTERISTICS OF RIGHT ELLIPTICAL RAKED-OFF CONES FOR CONE THICKNESS RATIOS OF 0.25 TO 3

Robert H. Lamb, Ralph E. Graham, and Paul O. Romere Washington, NASA, Aug. 1965 70 p refs

(NASA-TN-D-2947) CFSTI: HC $3.00/MF $0.75 CSCL 01A

A parametric study has been made of the Newtonian aerodynamic characteristics of right elliptical raked-off cones, in general, for cone thickness ratios of 0.25 to 3.0 and, in particular, to determine a range of configurations which might be used as heat shields for manned vehicles entering the earth's atmosphere at hyperbolic speeds. Newtonian longitudinal aerodynamic force and moment coefficients for angles of attack of ±15° are presented. Also presented are the values of base thickness ratios and lateral surface areas which coincide with the configurations considered. It was found that, for low cone thickness ratios, the longitudinal stability limit is the limiting factor from the standpoint of a realistic center-of-gravity location. However, as the cone thickness ratio increases, the center-of-gravity limit becomes a function of the directional stability limit. The lateral stability limit is never the determining factor. The lift-to-drag ratio was found to increase with increasing cone thickness ratio and to be a function of the rake angle and the cone half-angle measured in the vertical plane. After restricting the cone to trim at zero angle of attack, to have a minimum lift-to-drag ratio of 0.6, and to have longitudinal, directional, and lateral stability, it was found that only three cone families met the restrictions. Newtonian longitudinal force and moment coefficients for the resulting three families, for the complete angle-of-attack range of 0° to 360°, are presented. Author

N65-30033# Cincinnati Univ., Ohio.

NEW APPROACH TO THE TWO-DIMENSIONAL HYPERSONIC BLUNT BODY PROBLEM Interim Technical Report

Kinzo Hida Wright-Patterson AFB, Ohio, ARL, Jan. 1965 27 p refs

(Contract AF 33(616)-8453)

(ARL-65-15; AD-615901)

Hypersonic flow past a two-dimensional blunt body has been treated by making use of the technique of the perturbation of independent variables. Application to a flat plate normal to the oncoming flow leads us to the same results as those obtained by a different procedure. One more term is found for the stand-off distance of a shock wave. The case past an arbitrary body is also considered. Author

N65-30035# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

AN EXPERIMENTAL INVESTIGATION OF ROTOR HARMONIC AIRLOADS INCLUDING THE EFFECTS OR ROTOR-ROTOR INTERFERENCE AND BLADE FLEXIBILITY Final Technical Report, Mar. 1, 1963–Aug. 31, 1964

Norman D. Ham and Paul A. Madden Ft. Eustis, Va., Army Aviation Mater. Labs., May 1965 62 p refs

(Contract DA-44-177-AMC-22(T))

(ASRL-TR-117-1; USAAML-TR-65-13; AD-615922)

Experimental airload harmonics from the first to the tenth at various blade spanwise stations are presented for single and rear tandem rotor configurations for various rotor angles of attack, tip-speed ratios, and thrust loadings. The results include the effect of blade bending motion on airload harmonics for selected test cases. Evaluation of the experimental results indicates several general conclusions of importance with regard to vibration levels of compound helicopters, tandem helicopters, and three- and four-bladed rotors. Author

N65-30075# Royal Aircraft Establishment, Bedford (England).

PRELIMINARY MEASUREMENTS OF THE FLOW FIELD ON THE LEESIDE OF A DELTA WING OF UNIT ASPECT RATIO AT A MACH NUMBER OF 2.6 AND AN INCIDENCE OF 15°

L. Gaudet and K. G. Winter London, Min. of Aviation, Sep. 1961 16 p refs

(RAE-TN-AERO-2787)

The measurements were made in the R.A.E. 8 ft × 8 ft wind tunnel, using a self-aligning yawmeter, over a plane normal to the model longitudinal axis at 82.5% root chord from the apex. They show a region of large total pressure loss and large flow direction variation about the leading edge vortex and another region of total pressure loss attributed to the bow shock wave. Between the regions affected by the leading edge vortices and the region affected by the bow shock wave there is an area of fairly small total pressure loss and flow direction deviation. The vortex is located well inboard of its position for similar incidence at low speeds. The streamwise Mach numbers near the core are of doubtful accuracy but, as measured, are smaller than freestream in contrast to the high velocities found there in incompressible flow. Author

N65-30077# Royal Aircraft Establishment, Bedford (England).

AN EXPERIMENTAL INVESTIGATION AT SUPERSONIC SPEEDS OF THE CHARACTERISTICS OF TWO GOTHIC WINGS, ONE PLANE AND ONE CAMBERED

L. C. Squire London, Min. of Supply, May 1959 51 p refs

(RAE-TN-AERO-2620)

Tests have been made at supersonic speeds up to M = 2.0 on a thick cambered gothic wing of aspect ratio 0.75, together with tests on the uncambered wing of the same planform and thickness. The camber was designed to give attached flow all along the leading edge, and over the whole wing, at one lift coefficient, together with low drag at this lift. The thickness distribution was chosen to have low zero lift drag and also to eliminate the adverse pressure gradients due to incidence and camber at the design lift. The results show that the drag of the cambered wing is close to the theoretically estimated value at the design lift coefficient: the drag of the plane wing, however, is also of the same magnitude and the reasons for this are discussed. Other properties of the wings are not in agreement with the slender thin wing theory. At the design condition on the cambered wing the flow is attached over the whole wing. Off the design condition the leading edge separations on the cambered wing are much weaker than on the plane wing.

Author

N65-30082# Royal Aircraft Establishment, Farnborough (England).
THE USE OF PARACHUTES AT HIGH SPEED AND HIGH ALTITUDE
M. H. L. Waters and A. C. Browning London, Min. of Aviation, Aug. 1961 48 p refs
(RAE-TN-MECH-ENG-340)

Parachutes are considered quite generally as inflatable drag devices, and their use in rocket recovery is studied. The speeds concerned are supersonic, and the altitudes range up to 30,000 ft, which is the effective limit of the earth's atmosphere. Most of the note discusses the higher altitude region (100,000 to 300,000 ft) where forced inflation is necessary, and aerodynamic heating is an important factor. On the basis of vertical re-entry trajectories broad design limits for drag devices are suggested, and weight estimates made. Satellite recovery is not treated, but the techniques needed there are common to rocket recovery. It is concluded that parachute systems are practical for recovering rocket parts, and experiments needed to develop such systems are outlined. Author

N65-30116# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
UNSTEADY AERODYNAMICS FOR ADVANCED CONFIGURATIONS. PART II: A TRANSONIC BOX METHOD FOR PLANAR LIFTING SURFACES
E. R. Rodemich and L. V. Andrew May 1965 117 p refs
(Contract AF 33(657)-10399)
(SID-64-1512-2; FDL-TDR-64-152, Pt. II; AD-618097)

The fundamental equations of the transonic box method were derived, based on the representation of the velocity potential by a doublet distribution. They form the basis of a systematic method of treating an oscillating wing at M = 1, analogous to the supersonic Mach box method. A digital computer program, written in Fortran IV, is presented. The program applies to a planar wing of polygonal planform, with a straight trailing edge, and as many as three sweep angles along the leading edge. For a maximum of ten modes of oscillation, the program computes the oscillatory potentials and pressures and a generalized force matrix. Results obtained from the program are compared with existing theoretical and experimental values. Several possible extensions of the method are described. Author

N65-30154# Kaman Aircraft Corp., Colorado Springs, Colo. Kaman Nuclear Div.
FEASIBILITY OF A MATHEMATICAL/STATISTICAL TECHNIQUE TO ESTIMATE MAXIMUM AEROSPACE VEHICLE RESPONSE TO WIND Final Report, 1 Jul. 1964–31 Mar. 1965
C. Eugene Buell 31 Mar. 1965 73 p refs
(Contract AF 19(628)-4299)
(KN-65-699(FR); AD-617352)

The feasibility of a mathematical/statistical technique for determining the distribution of maximum aerospace vehicle structural and control response from the more advanced presentations of upper-wind climatology (means, standard deviations, and inter-level correlation matrices of orthogonal wind components at equally spaced levels) is investigated. It is concluded that the development of such a technique is feasible but not without some problem areas. The steps of development of such a technique appear to be as follows: First, the development of a reasonable linear system of differential equations that is equivalent (in a special sense) to the dynamical equations of motion and response of the vehicle. Second, the establishment of the relation of response statistics of the vehicle to the wind statistics by means of the preceding differential equations. Third, from the statistics of vehicle response, to determine the statistics of the maximum vehicle response. Some preliminary results in several of the important areas are outlined. Author

N65-30163# Polytechnic Inst. of Brooklyn, Freeport, N. Y.
AN EXPERIMENTAL INVESTIGATION OF THE NEAR WAKE OF A SLENDER CONE AT M_∞ = 8 AND 12
Robert J. Cresci and Victor Zakkay Wright-Patterson AFB, Ohio, ARL, May 1965 51 p refs
(Contract AF 33(606)-7661)
(ARL-65-87; AD-617622)

Various experimental data have been obtained in the near wake region of a 10° angle sharp cone at free stream Mach numbers of 8.0 and 11.8. The tests conducted in a blowdown type tunnel using fine wires to support the model. The Mach 8.0 tests were conducted at free stream Reynolds numbers of 0.3×10^6 and 1.7×10^6 per foot; laminar and turbulent boundary layers were obtained on the cone surface at these respective Reynolds numbers. Data obtained include radial profiles of temperature, pressure, and Mach number at axial locations between one and three base diameters downstream of the model. Heat transfer and pressure distributions on the model base were also obtained. The Mach 11.8 tests were conducted at a free stream Reynolds number of 0.6×10^6 per foot and the surface boundary layer for all these tests were laminar. Data obtained include centerline distributions of Mach number, pressure, and temperature for a distance between one and four base diameters downstream of the model. Centerline temperatures were also obtained in the recirculation region for model wall to stagnation temperature ratios of 0.06 and 0.47. In addition, total temperature profiles were obtained downstream of the rear stagnation point. Author

N65-30184*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DETERMINATION OF AERODYNAMIC FORCE AND HEAT TRANSFER PROPERTIES FOR A CONCAVE HEMISPHERICAL SURFACE IN FREE MOLECULAR FLOW
Clarence Ray Wimberly 28 Jun. 1965 45 p refs
(NASA-TM-X-53288) CFSTI: HC $2.00/MF $0.50 CSCL 01A

An analysis of a concave hemispherical surface in free molecule flow is presented where the surface is oriented at an arbitrary angle of attack. General equations are formulated for the lift, drag, and heat transfer coefficients. The molecules are assumed to obey Maxwell's velocity distribution law before and after collisions, reflecting directionally in a cosine distribution. It is further assumed that the reflecting molecules are perfectly accommodated to the surface conditions. The resulting equations are not in closed form, but have been solved numerically for some typical values of the molecular speed ratio and surface-to-ambient-temperature ratio. It is found that under the above conditions the heat transfer characteristics are the same as those of a convex hemisphere. The drag is increased slightly over its counterpart, while the total lift is shown to be very small and would be zero except for interreflected molecules. Maximum drag and heat transfer occur at zero angle of attack, decreasing to zero at ninety degrees angle of attack. Author

N65-30185*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEWTONIAN AERODYNAMICS FOR TANGENT OGIVE BODIES OF REVOLUTION
Edward E. Mayo Jun. 1965 34 p refs
(NASA-TM-X-55235; X-671-65-244) CFSTI: HC $2.00/MF $0.50 CSCL 01A

Aerodynamic coefficients and static stability characteristics of tangent ogive bodies of revolution are presented. The body fineness ratio varied from a hemisphere (fineness ratio = 0.5) to a fineness ratio of 7 and the angle of attack ranged from 0 to 180 degrees. Since, for most applications, and afterbody will be added to the tangent ogive to form a complete vehicle, the aerodynamics presented do not include the effects of the base. An increase in fineness ratio resulted in increased lift, decreased drag and, subsequently, a rapid increase in the lift-to-drag ratio. Near zero lift, the agreement between the impact theory and existing experimental stability values improves with increasing Mach number with the exception of the normal force derivative for fineness ratios less than 4. The axial force coefficient is not adequately predicted by the impact theory, particularly at low angles of attack where the skin friction and base drag become significant contributors to the total drag. Author

N65-30189*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION OF DRAG AND STABILITY OF PARACHUTES AT SUPERSONIC SPEEDS

Nickolai Charczenko Washington, NASA, Aug. 1964 24 p refs (NASA-TM-X-991) CFSTI: HC $1.00/MF $0.50 CSCL 01A (Declassified)

An investigation has been made in the Langley Unitary Plan wind tunnel to determine drag and stability characteristics of flat-roof conical-inlet parachutes at Mach numbers from 2.30 to 4.65. The results are compared with those for conventional ribbon-type parachutes and with those for other drag devices. The flat-roof conical-inlet parachutes provided large improvement in drag and stability over conventional ribbon-type parachutes in the test Mach number range. Larger values of drag resulted from the use of shroud lines equal in length to 2 parachute diameters as compared with values obtained with shroud lines equal to 1 parachute diameter. Fluctuating drag loads due to a change in shape and position of the shock wave existed for all parachutes and under all testing conditions. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-29167# Bolt, Beranek, and Newman, Inc., Los Angeles, Calif.

ANALYSIS OF COMMUNITY AND AIRPORT RELATIONSHIPS/NOISE ABATEMENT, MAY 1963–APRIL 1964. VOLUME II: DEVELOPMENT OF AIRCRAFT NOISE COMPATIBILITY CRITERIA FOR VARIED LAND USES

Dwight E. Bishop Dec. 1964 103 p refs
(Contract FA-WA-4409)
(BBN-1093; SRDS-RD-64-148, II)

The three volumes of this report describe engineering and research activities undertaken towards determining the technical basis and procedures for assessing and predicting community response to noise. Volume II describes in detail two simplified procedures for analyzing aircraft noise in the vicinity of airports to determine: (a) whether or not aircraft noise will interfere with work activities or land use; and (b) what building arrangements and construction features should be incorporated in building design so that aircraft noise will not interfere with activities inside the building. Author

N65-29228# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.

INVESTIGATION OF A TIME-FREQUENCY TECHNIQUE FOR RANGE AND RANGE-RATE MEASUREMENTS Final Report

A. J. Mantwilla and Karl Burkard May 1965 52 p refs
(RD-65-54)

A flyable breadboard device utilizing a stable atomic clock to derive range and relative closing speed of two aircraft was built and installed aboard two Federal Aviation Agency aircraft. The ratio of range and relative closing speed is used to approximate time to nearest approach (tau) for assessing collision threats. An analysis of the results indicated that the technique is a feasible method of determining range and relative closing speed (range-rate) and is applicable to assess airborne collision threats. Author

N65-29483*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE IMPACT OF V/STOL AIRCRAFT ON INSTRUMENT WEATHER OPERATIONS

John P. Reeder [1964] 22 p refs Presented at the AGARD Flight Mech. Panel Meeting on "All Weather Operation", Munich, 12–14 Oct. 1964
(NASA-TM-X-54740) CFSTI: HC $1.00/MF $0.50 CSCL 01C

One of the benefits to be gained from the use of V/STOL aircraft is the reduction of weather minima for safe, operational use. In order to insure this possibility in the next 10 to 15 years, it is considered necessary to expedite work along the following: (1) improvement of the aircraft handling qualities to make the pilot workload comparable with present CTOL aircraft; (2) development of vastly improved pilot displays; and (3) development of practical precision instrument approach techniques. Also, to use V/STOL aircraft in high-traffic-density terminal areas effectively, a new approach to the ATC system is advisable and arrangements should be provided for separate approach and landing facilities for these aircraft where the same airports are used for CTOL aircraft. E.E.B.

N65-29594# Bolt, Beranek, and Newman, Inc., Los Angeles, Calif.

ANALYSIS OF COMMUNITY AND AIRPORT RELATIONSHIPS/NOISE ABATEMENT. VOLUME III: DISCUSSION OF SOME LEGAL ASPECTS OF AIRCRAFT NOISE Work Accomplishments, May 1963–Apr. 1964

Dwight E. Bishop Dec. 1964 30 p refs
(Contract FA-WA-4409)
(BBN-1093; RD-64-148, III)

Volume III of the report discusses legal aspects helpful in understanding some of the actions taken by individuals or by groups in a community responding to aircraft noise. Possible legal actions, with an assessment of the probability of successfully sustaining legal action, are discussed in terms of the physical relationship of aircraft and the ground observer, and the type of noise exposure which is likely to be encountered with current commercial aircraft operations. Author

N65-29629# Royal Aircraft Establishment, Farnborough (England).

A THEORETICAL ASSESSMENT OF VARIOUS CONTROL LAWS FOR USE IN A TAKE-OFF DIRECTOR FOR LARGE AIRCRAFT

D. E. Fry and M. R. Watts London, Min. of Aviation, Jun. 1964 74 p refs
(RAE-TN-IEE-50)

A theoretical study has been made of the performance of three large aircraft, when various control laws are used in a take-off director. The work assumed a perfect response by the pilot. Ground effect was not taken into account and constant lift and drag coefficients were used. The aircraft responses after lift-off, to various control laws were examined and a more detailed investigation has been made of one of the systems, throughout the whole take-off maneuver. This system demands a rate of pitch proportional to the sum of longitudinal acceleration and speed error and would appear to provide a satisfactory basis for a take-off director. Author

N65-29635# Royal Aircraft Establishment, Farnborough (England).
DISINTEGRATION OF INSECTS BY BLASTS OF AIR
D. C. Jenkins and J. D. Booker Dec. 1964 17 p refs
(RAE-TR-64095)

Low flying aircraft may have the forward view through the transparencies impaired by smears caused by impacts with insects. To determine whether an aircraft hot air rain clearance system would be capable of disintegrating insects and deflecting them from the windscreen, laboratory tests were made using an air gun to apply air blasts to insects of several species typical of those likely to be met in flight. Flash photographs taken during the application of the blast show that the majority of insects are unlikely to be disintegrated sufficiently for their remains to be deflected from the windscreen by rain clearance jets. Author

N65-29641# National Gas Turbine Establishment, Pyestock (England).
AIRCRAFT NOISE AND ITS POSSIBLE INFLUENCE ON CHOICE OF POWER PLANT INSTALLATION
R. Holl and Z. M. Jawor Apr. 1957 21 p refs
(NGTE-NT-277)

The noise from a turbojet engine is examined and suggestions are made regarding a possible noise rating for different engines. The flight performance of engine types which would give acceptable noise levels at take-off without resorting to noise suppression devices is examined with particular reference to high subsonic and low supersonic flight speeds. At M = 0.87 the bypass type of engine operating with a bypass ratio of 1.0/1 or above is estimated to be sufficiently quiet and offers advantages in the form of low specific fuel consumption. At M = 1.20 it appears that a turbojet operating with a low turbine inlet temperature is more attractive by virtue of its higher specific thrust. The application of the jet flap to the high speed passenger-carrying aircraft could result in the development of an aircraft which would be entirely free from trouble due to noise. Author

N65-29762 Crane (Joe) Co., Mineola, N. Y.
PARABRAKES AND THEIR POSSIBLE USE ON COMMERCIAL AIRCRAFT
Joe Crane *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 123–126 (See N65-29750 18-05)

The advantages of parabrakes (drag chutes) and their recommended use on commercial aircraft are discussed. The military use of parabrakes, and their use under conditions of hydraulic malfunction, runway overshooting, and hydroplaning are presented. Their low cost and light weight are compared to the more expensive arresting gear and barrier nets. R.N.A.

N65-29763 Air Force Dept., Norton AFB, Calif. Life Sciences Div.
TRENDS IN USAF AIRCREW ESCAPE
Robert H. Shannon, Samuel P. Chunn, and William R. Detrick *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 127–135 (See N65-29750 18-05)

There has been little change in the basic equipment and method of aircraft escape since the introduction of the parachute. However, escape from high performance aircraft required the use of an ejection seat to insure clearance of the cockpit and external structures. Escapes changed from predominantly bailouts in the early fifties to predominantly ejections in the late fifties. There has also been an increase in the proportion of rocket assisted ejections in comparison to conventional ballistic ejections. The majority of escape fatalities and injuries regardless of escape method occurred during parachute landing. Inability to survive parachute water landings was the second leading cause of fatalities. There is a high fatality rate in escape attempts at low altitudes, particularly below 500 feet. However, ejection methods greatly reduce the risk. Speed has not proven to be a critical factor in either bailout or ejection. Although escape systems and methods have been improved, preventable fatalities and injuries continue to occur. R.N.A.

N65-29764 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
EJECTABLE NOSE CAPSULE TRACK TEST PROGRAM
B. J. White *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 136–156 (See N65-29750 18-05)

A rocket track sled test program was conducted on ejectable nose capsules to establish design criteria for an escape system for high performance aircraft. The test equipment, recovery system, and test instrumentation are described; and a summary of test conditions and results are presented. The program demonstrated the feasibility of the separable nose capsule escape system and showed that successful escape is possible at high dynamic pressures and low altitude. R.N.A.

N65-29766 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
CREW ESCAPE CONCEPTS FOR LOW ALTITUDE ESCAPE
Marvin C. Whitney *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 195–204 (See N65-29750 18-05)

This paper will present the problems associated with low altitude escape for advanced flight vehicles. First a determination is made of the crew escape design requirements for low altitude escape and especially for vehicles capable of low altitude flight. This will cover not only near zero velocities required for VTOL vehicles, but also transonic velocities required of vehicles capable of a dash mission. After the requirements have been determined, various crew escape concepts such as open ejection seats, encapsulated seats, and separable crew compartment capsules will be briefly coverad along with the associated escape problems such as stability, critical timing, automatic initiation, high dynamic forces, high performance escape rockets, etc. Possible techniques and concepts that will meet various vehicle requirements for low altitude escape will then be discussed. Author

N65-29767 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
THE SEPARABLE CREW COMPARTMENT CAPSULE FOR EMERGENCY ESCAPE
R. F. Dobbek *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 205–222 (See N65-29750 18-05)

This paper discusses the two basic types of separable crew compartments as an emergency escape technique. The apparent degree of crew protection is developed through discussion of the capability of the technique to meet extremely high performance flight requirements and unique flight conditions. The basic differences between typical configurations of separable crew compartments and their predecessors, i.e.; ejection seats and encapsulated seats in the area of aerodynamics are discussed. The technical involvement of the aerodynamic and structural interfaces between capsule and vehicle is presented. An analysis is included of the contribution made by the higher mass of these capsules toward better slow speed stability during ejection rocket burning, and the part that rapid system actuation and sequencing plays under these flight conditions. General discussion of the effects on survival of the downed crew as a result of using the separable crew compartment escape technique is set forth. Finally, possible unique advantages attained through the use of these capsule systems in the fields of aircrew training and aircraft maintenance. Author

N65-29839# Ryan Aeronautical Co., San Diego, Calif.
FLEXIBLE WING AIR CARGO GLIDER DELIVERY SYSTEM Final Summary Report
N. Sakamoto and G. Cota Ft. Eustis, Va., Army Transportation Res. Command, May 1965 80 p refs *Its* Rept.-648120
(Contract DA-44-177-AMC-868(T))
(TRECOM-TR-65-11; AD-615908)

The results of a flight test program utilizing a flexible wing air cargo delivery vehicle are presented in this report. The objective of the program was to prove the feasibility of this vehicle for the delivery of cargo in a logistic system. Discussed are performance characteristics and handling qualities of both the towed flexible wing and the tow helicopter. Author

N65-29840# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IN AIR TURBULENCES
B. Nikitin 7 May 1965 7 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 12 Jul. 1964 p 4
(FTD-TT-64-1360/1; AD-615993)

The experiences of a Soviet navigator and pilot in a target search and destination exercise at night are narrated. The relationship between the vectoring navigator and the interceptor plane armed with rockets was considered part of the mission success. W.M.R.

N65-29865# Defense Documentation Center, Alexandria, Va.
PARACHUTE TECHNOLOGY A Report Bibliography
Samuel A. Tancredi, comp. Jan. 1964 106 p refs
(AD-427014)

An annotated bibliography is presented on parachute technology and includes subject material pertaining to aerial delivery, canopies, materials, parachute types, recovery systems, physical effects, and testing. R.N.A.

N65-30002# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CIVIL AVIATION Selected Articles
29 Jan. 1965 21 p Transl. into ENGLISH of 2 articles from Grazhdanskaya Aviatsiya (Moscow), no. 1, 1964 p 11–13, 20–21
(FTD-TT-64-826/1; AD-610790)

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1. SECOND BIRTH OF MACHINES B. Belko p 1–12
2. GRAVIMETRIC SURVEY FROM HELICOPTER Yu. Davidenko p 13–18 (See N65-30003 18-02)

N65-30003 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GRAVIMETRIC SURVEY FROM HELICOPTER
Yu. Davidenko *In its* Civil Aviation 29 Jan. 1965 p 13–18 (See N65-30002 18-02)

Flight procedures are given for an Mi-1 helicopter making a gravimetric survey in mountainous regions during the winter. R.N.A.

N65-30010# General Electric Co., Cincinnati, Ohio.
INVESTIGATION OF METHODS FOR THE PREDICTION AND ALLEVIATION OF LIFT FAN NOISE Final Report, Jul. 1963–Aug. 1964
Harry D. Sowers Ft. Eustis, Va., Army Transportation Res. Command, Apr. 1965 163 p refs
(Contract DA-44-177-AMC-72(T))
(USATRECOM-TR-65-4; AD-616267)

Theoretical investigations have provided insight into the basic noise generating mechanism of fan noise. Analysis of the mechanism has included the classical theories of sound propagation as well as aerodynamic cascade theories and small perturbation concepts. Acoustic normalizing techniques have resulted in a correlation curve of the overall sound power for 13 separate fan and compressor vehicles with each one being from a different design family. Investigation of noise minimization through design techniques incorporates the results of the analytical investigations and the normalized sound power relations. Results indicate the effect of rotor-stator spacing, blade number, RPM, inlet length and centerbody design. Suppression techniques evaluated were wave cancellation, deflection, and absorptive suppressor designs. Noise data are presented in table form for the sound pressure measurements made on each configuration. Author

N65-30040# Mississippi State Univ., State College. Dept. of Aerophysics.
THE MARVEL PROJECT. PART E: A UNIQUE SOLUTION TO THE PROBLEM OF OBTAINING TWO-DIMENSIONAL BOUNDARY LAYER DATA ON THE VARIABLE-CAMBER HIGH-LIFT WINGS OF THE MARVELETTE AIRCRAFT
Sean C. Roberts May 1965 36 p *Its* Aerophys. Res. Rept. 56
(Contract DA-44-177-AMC-892(T))
(USATRECOM-TR-65-16; AD-615928)

This paper reports on the design, construction, instrumentation and preliminary testing performed on the high-lift wing of the MARVELETTE aircraft in a two-dimensional wind tunnel. The wind tunnel, 12 feet high and 2 feet 9 inches wide, was fitted over a section of the aircraft wing to the shrouded propeller at the rear of the vehicle. When operating with this arrangement, wind tunnel velocities up to 60 miles per hour were obtainable in the test section. The tunnel provided more data in a few weeks of operation than would have been obtained in a number of months using a flight program with a considerable number of flights close to minimum flight speeds. Author

N65-30078# Royal Aircraft Establishment, Bedford (England).
SOME NOTES ON THE INSTRUMENTATION FOR MEASUREMENT OF GROSS AND NETT THRUST IN FLIGHT ON THE FAIREY ER 103 AIRCRAFT
D. R. Andrews London, Min. of Supply, Feb. 1958 26 p refs
(RAE-TN-AERO-2548)

Instrumentation is being prepared to study and compare various methods of measuring gross thrust and engine mass flow in flight on the Fairey ER103 aircraft. This note gives

details of the various techniques to be used, of the instrumentation to be fitted, and the general manner in which the test programme will be conducted. Author

N65-30079# Royal Aircraft Establishment, Farnborough (England).
FLIGHT MEASUREMENTS OF THE PRESSURE ERRORS OF A NOSE AND A WING BOOM AIRSPEED SYSTEM ON A SWEPT-WING AIRCRAFT (HUNTER F, Mk. 1) AT MACH NUMBERS UP TO 1.2
D. R. Andrews and J. E. Nethaway London, Min. of Supply, Jan. 1955 35 p refs
(RAE-TN-AERO-2354) (Declassified)

The pressure errors of an experimental nose boom airspeed system and of the standard wing tip installation on a Hawker Hunter Mk I aircraft have been measured in flight. Tests were made at sea level by the "aneroid" method and at high altitude by the "formation" and "fly-past" methods. The results presented cover a range of speeds up to 500 knots and of Mach numbers up to 1.23. Author

N65-30130# Douglas Aircraft Co., Inc., Long Beach, Calif.
AIRCRAFT MOTION ANALYSIS
J. A. Thelander Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1965 105 p refs
(Contract AF 33(616)-6460)
(FDL-TDR-64-70; AD-617354)

This report is a compilation of coordinate systems, equations, and general relations used in aircraft-motion analysis. The information presented is useful for comparative evaluation and for preliminary-design work. Simplified and approximate solutions are given for special flight conditions. The material is defined and presented in a form suitable for direct application. Derivation and theoretical development are not emphasized, but sources thereof are named. Author

N65-30182 Society of Automotive Engineers, Inc., New York.
DEFINITIONS AND PROCEDURES FOR COMPUTING THE PERCEIVED NOISE LEVEL OF AIRCRAFT NOISE
15 Oct. 1964 8 p refs
(ARP-865)

Noys value as a function of sound pressure level is presented in tabular form for various band center frequencies. A conversion table is included for computing perceived noise level of aircraft noise from measured noise data, and the calculation procedure is outlined. M.W.R.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-29145# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF GULTON INDUSTRIES, INC. 5.0 AMPERE-HOUR NIMBUS CELLS
23 Jun. 1965 13 p
(Contract NASw-11-252-B)
(NASA-CR-63912; QE/C-65-460) CFSTI: HC $1.00/MF $0.50 CSCL 10C

Five ampere-hour nickel cadmium Nimbus secondary spacecraft cells were evaluated in order to derive specific information concerning performance characteristics and limitations, including cycle life under various electrical and environmental conditions; and cell weaknesses, including causes of failure of present designs. It was concluded that: the ceramic seals of these cells were satisfactory as evidenced by no leakers of the 30 cells tested, internal shorting was a weak point as evidenced by five rejects of the cells tested, and the capacity of the cells was in the acceptable range of 5.00 to 6.63 ampere-hours to 1.00 volt. It was recommended that an investigation be initiated to determine the causes of and methods to eliminate internal shorting problems. S.C.W.

N65-29146*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
BRUSHLESS D.C. TORQUE MOTOR Third Quarterly Report, 25 Dec. 1964–25 Mar. 1965
W. W. Yates and R. E. Skamfer [1965] 15 p
(Contract NAS5-3934)
(NASA-CR-63913; WAED-65-21E) CFSTI: HC $1.00/MF $0.50 CSCL 13G

A brushless d-c torque motor is developed. Tests taken on the completed units indicated that the magnet flux was approximately as calculated. The reluctance switch performed approximately as predicted. However, a severe cogging problem in the motor has necessitated rewinding the motor stators using a different punching and the installation of a magnetic can in the stator bore. Rework of the motors is scheduled to be complete by April 15, 1965. Engineering evaluation of the reluctance switch and control is proceeding. Author

N65-29148*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
CHARACTERIZATION OF NICKEL–CADMIUM ELECTRODES Final Report, 1 Jul. 1963–31 Dec. 1964
W. N. Carson, Jr., J. A. Consiglio, and R. R. Nilson [1964] 117 p
(Contract NAS5-3477)
(NASA-CR-63916) CFSTI: HC $4.00/MF $0.75 CSCL 10C

A method for the analysis and characterization of the electrodes used in nickel–cadmium spacecraft batteries was developed. Principle characterization data were the complete potential versus time curve for each electrode against a nickel oxide reference electrode for a small number of charge–discharge cycles (6-7) prior to assembling the electrodes into test cells for the cyclic tests. These curves show the electrode capacity, graphitic and antipolar capacity, and the effect of impurity levels. Positive electrodes were tested to determine the onset of gassing and gassing rate as a function of charging current. It is shown that the measurement of individual electrode potential versus reference electrodes, prior to and after cyclic testing, varies in capacities, and changes in graphitic and nitrate steps. There were no detectable correlations between the initial positive electrode capacities and the nitrate reduction step of graphitic capacities. No statistically valid correlation was developed between individual electrode characteristics, such as capacity, graphitic capacity, or nitrate capacities before and after cycling. M.W.R.

N65-29183# Joint Publications Research Service, Washington, D. C.
PNEUMONICS
Yu. Popov and Yu. Pukhnachev 28 Jul. 1965 17 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 1, 1965 p 10–18
(JPRS-31279; TT-65-31776) CFSTI: $1.00

A branch of automatic control engineering termed fluidjet controls engineering or, with respect to the pneumatic systems, pneumonics, is discussed. Automatic control is by means of the interaction of flows of a working fluid. These devices have the advantages of simplicity, reliability, low cost, and ease of production. Also, these devices can operate under the most varied conditions of overloads, vibrations, radiation, and temperature. The pneumonic amplifier, relay element, and aerodynamic oscillator are described. The analogy of pneumonics to electronics in control engineering is emphasized. E.E.B.

N65-29188*# Thermo Electron Engineering Corp., Waltham, Mass.
SOLAR ENERGY THERMIONIC (SET) PROGRAM, TASK II Final Report, 27 Oct. 1963–18 Dec. 1964
Pierre J. Brosens Dec. 1964 143 p Prepared for JPL (Contracts NAS7-100; JPL-950671)
(NASA-CR-63947; TE-34-65) CFSTI: HC $4.00/MF $1.00 CSCL 10B

Studies focusing on the development of an advanced converter structure capable of satisfying the geometrical constraints of a variety of generator designs, including those that use as many as 16 converters; and studies designed to improve converter performance, particularly at higher output voltages, by reducing the interelectrode spacing; are reported. Two converter prototype iterations with tantalum emitters, and three converters with rhenium emitters, were fabricated, designed, and tested. A summary of the results obtained with each converter is included. The main results of this program are summarized as follows: (1) an advanced converter structure with a 1-mil interelectrode spacing was developed which meets all the major geometrical conditions for use in multiconverter generators of a variety of designs, (2) interelectrode spacing was verified in two converters, (3) precise calorimetric data on the magnitude of electron cooling losses was obtained, (4) reference analytic models were established to facilitate the interpretation of converter performance, (5) a converter life of 560 hours without degradation in output or failure was demonstrated, and (6) the performance of one of the tantalum converters has not reached the expected level. S.C.W.

N65-29292# Deutsche Forschungsanstalt für Luft-und Raumfahrt, Brunswick (West Germany).
THE METHOD OF DYNAMIC PROGRAMMING AND ITS APPLICATION TO OPTIMIZATION PROBLEMS IN FLIGHT DYNAMICS [DIE METHODE DES DYNAMIC PROGRAMMING UND IHRE ANWENDUNG AUF OPTIMIERUNGSAUFGABEN DER FLUNGMECHANIK]
W. Schulz and H.-K. Schulze Dec. 1964 32 p refs In GERMAN; ENGLISH summary
(DLR-FB-64-44) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 8 DM

The method of dynamic programming, based on Bellman's principle of optimization, is suitable for application to problems of optimization, in which the conditions for the solution according to the classical indirect method of the calculus of variations are not satisfied, e.g. due to the existence of additional conditions in the form of inequalities. The application of the method of dynamic programming is explained by giving examples of optimization of a multistage rocket and of the estimation of brachistochronic trajectories. The experience regarding the computational procedure and questions regarding the accuracy are considered. Author

N65-29293*# Harshaw Chemical Co., Cleveland, Ohio.
DEVELOPMENT OF OPTICAL COATINGS FOR CdS THIN FILM SOLAR CELLS Second Quarterly Report, 1 Mar.–1 Jun. 1965
J. C. Schaefer and E. R. Hill Washington, NASA [1965] 25p (Contract NAS3-6464)
(NASA-CR-54452) CFSTI: HC $2.00/MF $0.50 CSCL 10A

The apparatus for RF sputtering of dielectrics is operational and films of glass have been deposited. Reflectance measurements indicate films in the range of 4 microns thickness to show the desired infrared reflectance characteristic. Work is underway to improve the deposited film thickness uniformity and increase the deposition rate. Oxygen is being added to the sputtering gas to reduce the stresses in the deposited films. Author

N65-29391*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WEIGHT OPTIMIZATION OF FINNED RADIATORS
R. J. Burian, J. J. Ketchman (Battelle Mem. Inst.), and Dale W. Harris 9 Oct. 1964 5 p Submitted for Publication
(NASA-TM-X-54784) CFSTI: HC $1.00/MF $0.50 CSCL 13A

Radiators for rejecting large amounts of waste heat from power generators in space are an important weight contribution to the generators. For the rejection of from a few hundred watts up to perhaps a few kilowatts of waste heat, straight fin radiators are the most practical. In a recent thermoelectric power generator weight optimization study conducted for NASA, a technique was established which permitted the rapid determination of the geometry of a minimum weight finned radiator system. From data presented in the literature, three design equations were derived which related twelve geometric, thermal, environmental and material parameters of an idealized fin system with no base cylinder interaction. An equation was derived to take into account the base cylinder interaction and reduce the idealized design to the realistic case. Three families of curves and auxiliary tables were prepared to assist in the rapid reduction of the idealized design equations. Author

N65-29442*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR CELL PERFORMANCE AT HIGH TEMPERATURES
Jacob D. Broder, Harold Kautz, Joseph Mandelkorn, Lawrence Schwartz, and Robert Ulman [1964] 14 p Presented at 4th Ann. Photovoltaic Specialist's Conf., Cleveland, 2–3 Jun 1964 (NASA-TM-X-51826) CFSTI: HC $1.00/MF $0.50 CSCL 10A

The temperature behavior of various resistivity unbombarded and bombarded silicon cells, and unbombarded and bombarded GaAs cells is discussed and compared. The characteristics discussed include the open circuit voltage, the maximum power output, and the curve power factor which is defined as the maximum power output divided by the product of the short circuit current and open circuit voltage. R.N.A.

N65-29447*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRPLANE TESTING OF SOLAR CELLS
Henry W. Brandhorst, Jr. [1964] 17 p Presented at the 4th Ann. Photovoltaic Specialist's Conf., Cleveland, 2–3 Jun. 1964 (NASA-TM-X-51946) CFSTI: HC $1.00/MF $0.50 CSCL 10A

An analytical and experimental evaluation of possible space charge flow configurations suitable for use in ion guns is presented. Emphasis is placed on accel-decel curvilinear flow configurations using conical or cylindrical ion emitter designs and yielding an almost parallel beam. Emitter current densities of at least 5 milliamperes per square centimeter are considered. Electrode geometries of minimum ion interception characteristics are also evaluated. Various solutions are examined for possible electron trapping regions which can facilitate beam neutralization. Discharge plasmas are investigated to determine basic plasma properties in an ion source. This includes a study of probe theory as a basis for measurement techniques and to provide a method of experimentally checking the theory. The design, fabrication, and experimental operation of a curvilinear flow ion emitter were conducted to verify the theoretical results as they were obtained. R.N.A.

N65-29489*# Stanford Univ., Calif. Electron Devices Lab.
DC STATES OF PLASMA DIODES Quarterly Status Report Q.R.R. No. 9, 1 Apr.–1 Jul. 1964
[1964] 26 p refs
(Grant NsG-29963)
(NASA-CR-58755) CFSTI: HC $2.00/MF $0.50 CSCL 10A

In view of the importance of charge exchange collisions in certain phenomena related to low pressure thermionic energy converters the mobility of positive ions subject to such collisions has been reviewed. An expression due to Sheldon for the charge exchange mobility at low electric fields is considered basically sound. However an equation for the drift velocity at high electric fields given by Sena has to be rejected because of his underlying assumption that the ions created start from rest. By properly balancing the momentum transfer in a charge exchange collision were have arrived at an integro differential equation for the ion distribution function. Work is in progress to solve this equation in order to find an expression for the charge exchange mobility at high electric fields. Author

N65-29597*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS Final Report
J. N. Ellis and F. A. Collins 26 Apr. 1965 74 p
(Contract NAS3-2783)
(NASA-CR-54321) CFSTI: HC $3.00/MF $0.75 CSCL 09C

This final report on the study of brushless rotating electrical generators for space auxiliary power systems describes eighteen types of brushless A.C. generators and recommends four for aerospace use. The reader is referred to the Topical Report NASA CR-54320 for the electrical and mechanical analysis methods resulting from the study. The Topical Report consists of five volumes containing 10 design manuals and 9 Fortran computer programs for use in calculating the electrical performance and characteristics of brushless A.C. generators. It contains generator selection aids, a discussion of gas bearings for generators, and a discussion of the problem of critical speeds. The report includes a Fortran computer program for generator thermal analysis plus examples, test data, derivations and discussions. Author

N65-29622*# American Cyanamid Co., Stamford, Conn. Stamford Research Labs.
RESEARCH AND DEVELOPMENT OF HIGH-PERFORMANCE LIGHT-WEIGHT FUEL CELL ELECTRODES Final Report, Nov. 1, 1963–Oct. 31, 1964
R. G. Haldeman, W. A. Barber, W. P. Colman, J. DiPalma, D. Gershberg et al 1 Aug. 1965 172 p
(Contract NAS3-2786)
(NASA-CR-54436) CFSTI: HC $5.00/MF $1.00 CSCL 10A

New catalyst materials, including high-area platinum blacks and platinum-rhodium mixtures, were prepared and evaluated. Also, various asbestos matrix materials were investigated. New high-performance, high-loading electrodes were developed. Life tests conducted in 2 inch by 2 inch cells showed these electrodes to be capable of stable operation for 1000 hr or more at 70° to 100° C. A scaled-up cell having 6 inch by 6 inch active area was constructed and operated successfully. Also, a 2 kW fuel cell battery system incorporating these electrodes together with bipolar separator plates was designed. The weight of this system exclusive of fuel and tankage was estimated to be about 50 lbs/kW. A mathematical analysis was used to predict for two cooling methods the temperature and concentration gradients within acceptable limits. E.E.B.

X65-29660# European Atomic Energy Community, Brussels (Belgium).
THE USE OF A NEW HEAT REMOVAL SYSTEM IN SPACE THERMIONIC POWER SUPPLIES
G. M. Grover (Los Alamos Sci. Lab.), J. Bohdansky, and C. A. Busse Jan. 1965 10 p refs
(EUR-2229.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 25 Belg. Fr.

Structures of very high thermal conductance known as heat pipes are described. For a specific method of fabrication and for operation in gravity free conditions, a relation is derived for computing the optimum heat transfer as a function of the pipe radius, length and the physical properties of the fluid. For a pipe of one centimeter radius and fifty centimeters long, the theory predicts heat fluxes of from 3 to 95 kilowatts. Possible uses of heat pipes in space power supplies are discussed. These uses depend strongly on the lifetime and operating temperature limits. Author

N65-29677*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
REPORT OF QUALIFICATION TEST AUXILIARY PUMP MOTOR, NASA 20M85118, WESTINGHOUSE P/N 939D261-1
May 1965 118 p refs
(Contract NAS8-11697)
(NASA-CR-64041; LY-15635) CFSTI: HC $4.00/MF $0.75 CSCL 13G

The Qualification Tests listed in this report were conducted on P/N 939D261-01 motor in accordance with the applicable specifications as modified by the contract. The results of the tests are described in this report. The thermostat initially included in the motor was a high temperature 160° C type located in a relatively cool area of the motor winding. The thermostat was replaced with a lower temperature 145° C type as a result of the thermal tests. Proof of thermal switch operation with the 145° C type is included on units No. 1 and No. 3. With the exception of dimensional discrepancies and overweight conditions listed under Section 2.01, Examination of Product, and the 30 minute run under 150 percent load at minimum voltage maximum frequency conditions described in detail under Section 2.07, Low Temperature Tests, the motor met all of the qualification test requirements of the applicable specifications. Author

N65-29717*# Lear Siegler, Inc., Cleveland, Ohio. Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS. VOLUME I: SELECTION CRITERIA Topical Report
J. N. Ellis and F. A. Collins 26 Apr. 1965 399 p refs
(Contract NAS3-2783)
(NASA-CR-54320) CFSTI: HC $7.00/MF $2.00 CSCL 13G

This report contains ten (10) design manuals and nine (9) computer programs for use in calculating the performance

and characteristics of brushless a.c. generators. It contains a computer program for use in calculating generator operating temperatures. It contains selection aids for use in choosing the proper generator for a specific application and has derivations and other supplemental aids. Author

N65-29742*# Thermo Electron Engineering Corp., Waltham, Mass.
TASK IV: (RESEARCH) OF THE SOLAR ENERGY THERMIONIC (SET) CONVERSION DEVELOPMENT PROGRAM Third Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
F. Rufeh, N. S. Rasor, D. Lieb, J. H. Weinstein, and S. S. Kitrilakis [1965] 114 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950671)
(NASA-CR-64021; TE67-65) CFSTI: HC $4.00/MF $0.75 CSCL 10A

Progress is reported on a program to generate detailed and accurate data on parameters involved in operating a thermionic converter. An improved analytical model of the cesium vapor diode was formulated. The relations which correlate the diode variables were obtained by considering the basic processes. These relations describe the form of the electrical characteristics satisfactorily under various conditions. The constants which yield quantitative agreement with experimental data are in good agreement with values computed from the atomic properties of cesium. Equations and techniques used in preparing a computer formulation for the parametric analysis are described. Computer runs, computer output summaries, and samples of graphical tabulations are shown. Thr results of a series of experiments are given in which only cesium fluoride is released into a tube while cesium is held in a capsule for later release. Data indicate that the relation between work function and coverage is more complex with cesium fluoride than with cesium. R.N.A.

N65-29778*# Naval Ammunition Depot, Crane, Ind.
LIFE CYCLE TESTS Monthly Progress Report, Period Ending 30 Jun. 1965
[1965] 139 p
(NASA Order W-11252-B)
(NASA-CR-64000) CFSTI: HC $4.00/MF $1.00 CSCL 10C

Life cycle test data are presented on 5 and 10 cell packs of nickel–cadmium and silver–zinc cells, and 10 cell packs of silver–cadmium cells. Test parameters are listed, failure analysis and capacity test data are tabulated, and data sheets giving end of discharge and end of charge voltage readings for each cell on each cycle recorded are included. R.N.A.

N65-29781*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
SOLAR THERMIONIC FLIGHT EXPERIMENT STUDY. VOLUME III: SPACECRAFT DESIGN (PHASE II) Final Report
P. Brosens et al 1 May 1965 427 p Prepared for JPL *Its* Doc.-65SD4286
(Contract NAS7-100; JPL-950852)
(NASA-CR-64031) CFSTI: HC $7.27/MF $2.25 CSCL 10A

The second phase of this study is concerned with efforts to develop spacecraft designs for the three missions selected in Phase I. In establishing the spacecraft designs, consideration is given to the following areas: (1) solar thermionic experiment design; (2) secondary experiments; (3) telemetry, tracking and command subsystem; (4) attitude control subsystem; (5) power subsystem; and (6) spacecraft structure and thermal control. The spacecraft designs will be conceptual in depth and establish the general configuration, performance and weight of the vehicles. N.E.A.

N65-29784*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIATION DAMAGE TO CADMIUM SULFIDE SOLAR CELLS
Henry W. Brandhorst, Jr. and Russell E. Hart, Jr. Washington, NASA, Jul. 1965 19 p refs
(NASA-TN-D-2932) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Cadmium sulfide thin-film solar cells were irradiated in vacuum with 2.5-, 1.0-, and 0.6-million-electron-volt electrons and 10-, 7-, 5-, and 2-million-electron-volt protons. Doses ranged from 10^{15} to 10^{17} electrons per square centimeter and from 10^{12} to 3.6×10^{14} protons per square centimeter. Three types of plastic encapsulant—polyethylene terephthalate, polyvinyl fluoride, and poly-imide—were also evaluated. The performance of the cells was measured before and after irradiation with a carbon-arc solar simulator. Cell dimensions were 1 by 2 centimeters, and efficiencies ranged from 1.3 to 2.5 percent and averaged 1.7 percent. Spectral responses of the cells were determined with a series of 18 monochromatic interference filters covering the range from 0.35 to 1.20 microns. Additional parameters measured under tungsten illumination included service resistance, dark and light shunt resistance, and the junction parameters A and I_0. Results of all the parameters evaluated are presented. N.E.A.

N65-29814*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHADOW EFFECTS ON A SERIES–PARALLEL ARRAY OF SOLAR CELLS
Ralph M. Sullivan [1965] 25 p
(NASA-TM-X-55289; X-636-65-207) CFSTI: HC $1.00/MF $0.50 CSCL 10A

Curves have been obtained to illustrate the effect of shadowing solar cells in a series–parallel solar cell array. Measurements of the degradation of the voltage–current curve and the power at a suitable operating point as a function of shadowing were made on a 48 by 8, series–parallel solar cell array for shadowing of series, parallel and series–parallel combinations. The results of the experiment are illustrated to provide a basis for extrapolation to any shadow-array configuration. Author

N65-29824*# Globe-Union, Inc., Milwaukee, Wis.
A PROGRAM TO DEVELOP A HIGH-ENERGY DENSITY PRIMARY BATTERY WITH A MINIMUM OF 200 WATT HOURS PER POUND OF TOTAL BATTERY WEIGHT Fourth Quarterly Report, Apr.–Jun., 1965
William E. Elliott, James R. Huff, Robert W. Adler, and Warren L. Towle 9 Aug. 1965 139 p
(Contract NAS3-6015)
(NASA-CR-54450) CFSTI: HC $4.00/MF $1.00 CSCL 10C

Eighty-five new anode-electrolyte combinations were studied in the continuation of a screening program designed to single out those systems which are most promising for further development. Among these, eight anode systems could sustain discharges at 100 mc/cm^2 without excessive polarization. An additional forty-two systems could sustain at least 10 ma/cm^2. Linearly varying potential and coulombic efficiency studies were initiated to provide a more extensive electrochemical evaluation of some of the anode systems which had exhibited promising characteristics in preliminary studies. Cupric fluoride cathodes prepared by dry-press techniques exhibited unsatisfactory electrochemical characteristics. Cathodes of lead dioxide and manganese dioxide yielded performances which were reproducible and superior to those of cupric fluoride, but did not perform well enough to be used in a high

energy density battery. Preliminary studies of soluble cathode depolarizer cells indicated that utilization of cathodes of this kind might be feasible, provided that it is possible to separate a soluble cathode depolarizer from an anode by some means without affecting cell performance. Author

N65-29991# Naval Ordnance Lab., Corona, Calif.
CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS RESERVE BATTERIES Quarterly Report, Jan.–Mar. 1965
15 Apr. 1965 54 p refs
(NAVWEPS-8813; AD-616549)

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3. AMMONIA CELL EXPLORATORY DEVELOPMENT J. C. Daley, G. E. Mc Williams, and W. C. Spindler p 12–41 refs (See N65-29994 18-03)
4. ANALYSIS AND EVALUATION OF CELL DATA W. C. Spindler p 41–51 refs (See N65-29995 18-03)

N65-29994 Naval Ordnance Lab., Corona, Calif.
J. C. Daley, G. E. Mc Williams, and W. C. Spindler *In its* Chemoelec. Energy Conversion for Nonaqueous Reserve Batteries 15 Apr. 1965 p 12–41 refs (See N65-29991 18-03)

Ammonia cell exploratory development included satisfactory performance of a transistorized fast switching test circuit for internal resistance measurements and determination that a $Pb/PbCl_2$ reference electrode did not affect cell performance. Although it had been hoped that introduction of $(NH_4)_2SO_4$ close to the anode would precipitate Mg ion and form insoluble $MgSO_4$, thus minimizing the undesirable effect of Mg cations on the cathode, the result was a pronounced adverse effect on internal resistance and performance was lowered. A series of cell tests with Pt, Ag, and stainless steel cathectors showed no significant difference in performance. R.N.A.

N65-29995 Naval Ordnance Lab., Corona, Calif.
ANALYSIS AND EVALUATION OF CELL DATA
W. C. Spindler *In its* Chemoelec. Energy Conversion for Nonaqueous Reserve Batteries 15 Apr. 1965 p 41–51 refs (See N65-29991 18-03)

An analysis is made of that portion of experimental error attributable to measurement, and the conclusion is that the component of error due to measurement only is less than total experiment variability by an order of magnitude, indicating that recorders of 1% or 2% uncertainty and the general test methods are adequate. Voltage, power, and energy relations in single cell performance are evaluated in terms of their relative importance to the intended battery applications, an ammonia battery in particular. It is concluded that, with respect to power, energy, or voltage efficiency, any one or two may be compromised in some cases to advantage of the remaining one or two if there has been an accurate definition of critical parameters for the intended applications. Cell energy conversion is analyzed in terms of an energy pyramid and by calculations using integral and average methods. R.N.A.

N65-30000# Army Electronics Labs., Fort Monmouth, N. J.
ORGANIC DEPOLARIZED PRIMARY BATTERIES Progress Report No. 1
Joseph C. Pawlak Mar. 1965 35 p refs
(ECOM-2567; AD-616120)

A detailed discussion of the performance of organic depolarized primary cells incorporating the most promising carbon blacks, with and without the addition of vanadium pentoxide (V_2O_5) to the cathode is presented. Cell performance data are included for a study of cathodic formulations conducted over a range of temperatures and discharge rates. Shelf life data for organic depolarized A-size Cells stored for periods up to three years are reported. A method devised to predict the capacity retention of an organic depolarized dry cell after storage is described. Author

N65-30013# Eagle-Picher Co., Joplin, Mo. Couples Dept.
RESEARCH ON AMMONIA BATTERY SYSTEM Final Report, Jul. 1, 1963–Aug. 31, 1964
D. J. Doan, L. R. Wood, and Leroy Folks [1964] 163 p
(Contract DA-36-039-AMC-02173(E))
(Rept.-16; AD-615973)

Data have been developed regarding cell energy density improvement and cells have been improved from 28.6 watt-minutes/inch^3 at the +125° F ambient. A six-cell series connected "mock-up" battery was tested at the +125° F ambient and 42.4 watt-minutes/inch^3 was achieved which projected into battery hardware results in about 4 watt-hours/pound. Operation of this unit at −65° F should yield approximately 6.0 watt-hours/pound. The best six-cell battery gave 2.0 watt-hours/pound. Both conventional and statistical experimentation have been utilized and from these studies, many specific factors that influence cell performance have been evaluated. The more pertinent factors are: cell void, electrolyte moisture content, type grid, discharge temperature, percent silver chloride and paste weight of the cathode and current density. Author

N65-30027*# Radio Corp. of America, Princeton, N. J.
THIN-FILM PHOTOVOLTAIC SOLAR ENERGY CONVERTERS Midpoint Report, 17 Dec. 1964–16 Jun. 1965
S. G. Ellis, R. R. Addiss, P. Vohl, and P. Rappaport 6 Jul. 1965 28 p ref
(Contract NAS3-6466)
(NASA-CR-54456) CFSTI: HC $2.00/MF $0.50 CSCL 10A

By growing the multilayer structure GaAs/InAs/Al foil, the resistance through the film has been decreased and the GaAs-to-Al connection made nonrectifying. Irregularities in the properties of the Cu_2Se films have been very much reduced by flash evaporating material which is carefully prepared to have a known stoichiometry. $Cu_2Se/GaAs/Ge$-Sn/Mo cells have been made with efficiencies up to 4.6% (without an antireflection coat). They were stable in air. $Cu_2Se/GaAs/InAs/Al$ cells have been made with efficiencies up to 4%, and a measured power-to-weight ratio up to 90 watts/lb (again without an antireflection coat). With an etching treatment, cells on Al have been made which show no degradation. Author

N65-30093# Radio Corp. of America, Harrison, N. J. Electronic Components and Devices Dept.
100 WATT THERMOELECTRIC GENERATOR Third Quarterly Progress Report, Jan. 1–Mar. 31, 1965
H. P. Van Heyst and O. H. Shade, Jr. 30 Apr. 1965 48 p refs
(Contract DA-28-043-AMC-00265(E))
(QPR-3; AD-617603)

A number of modifications were made on the thermoelectric couple design. These modifications were prompted by the module power output performance obtained during the last quarter. A number of modules incorporating the previous design were operated for extended periods under open circuit and matched load conditions, design operating temperatures and overshoot temperatures. The performance of these modules was reliable at the required operating conditions. The burner radiant construction has been established and has been found

to be a good compromise between heat transferring ability, desired flux distribution and service life. No major difficulties were encountered when the exhaust duct, vaporizer heat-exchanger, gasoline burner and thermoelectric converter were operational tested. These limited operational tests have shown that the burner combusts leaded gasoline in accordance with all design requirements. The starting burner was designed around a NGTE air blast atomizer. Initial tests on this burner indicate that it heats the vaporizer heat exchanger with little or no difficulty. Author

N65-30120# North American Aviation, Inc., Canoga Park, Calif. Rocketdyne Div.
HIGH-ENERGY BATTERY SYSTEM STUDY Quarterly Progress Report No. 7, 1 Jan.–31 Mar. 1965
J. Farrar, R. Keller, and M. M. Nicholson [1965] 27 p refs
(Contract DA-36-039-AMC-03201(E))
(R-5405-7; AD-617714)

A group of new cathode materials was tested in half-cell studies, including Br_2, I_2O_5, BrCN, CrO_3, CuS, FeS_2, $Ca(OCl)_2$, $CoSF_5$, and others. AgO, MnO_2, and CuF_2 were investigated further. Discharge curves were generally better in dimethyl sulfoxide than in propylene carbonate. Higher utilization efficiences were achieved at low-current densities. A lithium/water system was tested and a cell voltage of 2 volts was obtained over a period of 5 hours at a moderate discharge current density. Author

N65-30144# Eagle-Picher Co., Joplin, Mo. Couples Dept.
ADVANCED DEVELOPMENT MODELS OF VENTED NICKEL–CADMIUM BATTERIES Final Report, 5 Apr. 1964–15 Mar. 1965
Jeff K. Wilson 15 Mar. 1965 20 p ref
(Contract DA-28-043-AMC-00065(E))
(AD-617406)

Development and production work has been directed toward the production of forty (40) each BB-435/U, BB-437/U, BB-438/U and BB-439/U vented nickel–cadmium batteries. The work has been directed toward the attainment of a new line of nickel–cadmium batteries in accordance with the Signal Corps Technical Requirements SCL-6867B. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-29147*# California Univ., Berkeley.
[EXPERIMENTAL RESEARCH ON HEMODYNAMIC AND RELATED PHYSIOLOGICAL FUNCTIONS IN PRIMATES, AND PRIMATE HEMODYNAMICS AND METABOLISM IN AN ORBITING SATELLITE] Semiannual Status Report, 1 Aug. 1964–31 Jan. 1965
Nello Pace [1965] 18 p *Its* Rept. No. 6
(Grants NsG-170; NsG-513)
(NASA-CR-63915) CFSTI: HC $1.00/MF $0.50 CSCL 06C

This paper reports the present status of work performed to establish physiological procedures and instrumentation necessary for the automatic measurement of hemodynamic and metabolic parameters during prolonged periods of weightlessness. Specifically reported are: (1) evaluation of the monkeys to be used in experimental situations; (2) couch trials and isolation studies performed on some of the monkeys; (3) hemodynamic and hematological studies; and (4) urine analyses. N.E.A.

N65-29149*# Itek Corp., Palo Alto, Calif. Vidya Research and Development.
THEORETICAL AND EXPERIMENTAL STUDY OF THE ELASTIC BEHAVIOR OF THE HUMAN BRACHIAL AND OTHER HUMAN AND CANINE ARTERIES
E. Glenn Tickner and Alvin H. Sacks 20 Nov. 1964 113 p refs
(Contract NAS2-1137)
(NASA-CR-63917; Vidya-162) CFSTI: HC $4.00/MF $0.75 CSCL 06P

A combined theoretical and experimental investigation has been carried out to determine the elastic behavior of various excised human and canine arterial segments. The specimens were subjected to the combined loads of internal pressure and axial tension, and measurements were made for each loading condition. Arteries tested included the human brachial, external iliac, superior mesenteric and splenic, as well as the canine femoral and thoracic aorta. The arterial wall behaves as a nonlinear, homogeneous, anisotropic, compressible material and can be described by six elastic constants for each level of strain. Both the circumferential and axial stiffness are found to increase with internal pressure and both approach the value for the collagenous fibres at very high internal pressure and axial weight, respectively. The radial stiffness is found to be essentially independent of either internal pressure or axial loading. The relationship of this behavior to the presence and orientation of the collagen fibres is discussed in detail. The length of the arterial segment increases with pressure at low axial stress, but decreases with pressure at high axial stress. At in-vivo levels of internal pressure and axial stress, the artery length remains essentially unchanged, independent of loading. Further, at in-vivo levels, the artery behaves as though it were transversely isotropic, with equal stiffness in the circumferential and axial directions. Author

N65-29152# Queens Coll., Flushing, N. Y.
A LATENT STRUCTURE FOR THE SIMPLEX
W. A. Gibson [1960] 15 p refs
(Grant Nonr(G)-00033-63)
(AD-609676)

The Guttman simplex is refined for use in studying nonlinear relations in psychology. This simplex, which is a correlation matrix in which the values of the correlations decrease monotonically with increasing distance from the main diagonal, is based on a purely qualitative scale. A quantitative scale is proposed, in the form of a single underlying continuum for both variables. It is shown that transformation matrices can then be developed, such that when applied to an empirical correlation matrix, the result is a matrix of standard nonlinear regression scores. J.M.D.

N65-29159# John B. Pierce Foundation of Connecticut, New Haven.
SPATIAL SUMMATION OF PAIN FOR LARGE BODY AREAS
D. Murgatroyd Oct. 1964 50 p refs
(Contract DA-49-146-XZ-124)
(DASA-1568; AD-615479)

Spatial summation of pain was investigated using high intensity infra-red radiation. Cutaneous pain thresholds were determined for a total of eight subjects using apertures ranging from 1 cm^2 to 200 cm^2 on the face area, and 10 cm^2 to 1500 cm^2 for large body areas. Two methods of determining threshold—reaction time and method of constant stimuli—were utilized. Skin temperature at threshold was determined by a radiometric measuring device especially designed for use

during skin heating with infrared quartz lamps. Values so determined were checked by a computer solution of skin temperature rise using the best available data on the optical and thermal properties of the skin and found to be in close agreement. Results indicate that final skin temperature at threshold varied from 39.3° C to 46.7° C depending on subject, size of aperture, and area of body irradiated. A significant lowering of final skin temperature at threshold for the larger area occurred for all subjects when comparing apertures 1 cm^2 and 3 cm^2 on forehead and face areas, and apertures 10 cm^2 and 40 cm^2 on chest and back. A slight decrease in final sking temperature at threshold was generally noted for aperture sizes 5 cm^2 and 200 cm^2 on face areas but was not consistent for all subjects. When 40 cm^2 apertures were compared with full back and chest exposures, a higher threshold for the very large areas was obtained for three of the four subjects used. Author

N65-29171*# Public Health Service, Washington, D. C. Biophysics Section.
REDUCTION OF BACTERIAL DISSEMINATION. GERMICIDAL ACTIVITY OF ETHYLENE OXIDE. REDUCTION OF BACTERIAL CONTAMINATION ON SURFACES Third Quarterly Summary Report of Progress
May 1965 14 p
(NASA Order R-137)
(NASA-CR-63895) CFSTI: HC $1.00/MF $0.50 CSCL 06T

Experiments to determine characteristics of shedding of bacterial populations from the skin of adult males who have used a conventional bath soap without a specific antimicrobial agent and a germicidal detergent containing hexachlorophene for reduction of skin flora are reported. Preliminary results indicated little reduction of the bacterial populations shed by individuals using the conventional soap without hexachlorophene. The counts obtained from the same subject during the period when the germicidal detergent was used are markedly lower than those obtained when conventional soap was used. The study of the action of ethylene oxide gas against dust particulates laden with spores of *B. globigii* was continued using a static system for exposing contaminated glass surfaces. The results showed that a high level of kill was achieved under the test conditions; however, a small percent of the slides yielded growth when incubated in nutrient medium. Data on the survival of *B. globigii* on various surfaces exposed to 50° C and 40% relative humidity are also presented. E.E.B.

N65-29182# Joint Publications Research Service, Washington, D. C.
PROCEDURES FOR THE GRAPHIC RECORDING OF THE QUANTITY OF BIOLOGICAL FLUIDS
P. V. Lakhin et al 27 Jul. 1965 7 p refs Transl. into ENGLISH from Fiziol. Zh., Akad. Nauk Ukr. RSR (Kiev), v. 10, no. 4, Jul.–Aug. 1964 p 558–560
(JPRS-31269; TT-65-31766)

A method for reliable graphic recording of secretory and excretory processes using a piezoelectric crystal recording element and a specially constructed ac amplifier is described. The method avoids the shortcomings of the mechanical systems of recording and the actions of electric current on the drops of solution. In recording drop counts, the amplifier converts the impact oscillations into single impulses thus rendering the recording system relatively free of inertness. R.N.A.

N65-29209# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
INTERACTION BETWEEN DNA AND RNA OF *B. STEAROTHERMOPHILUS* INVOLVING ONLY ONE HALF OF THE TOTAL DNA
M. Ageno, M. Arca, E. Dore, C. Frontali, L. Frontali et al 15 Dec. 1964 53 p refs
(ISS-64/47)

Experiments are described, which demonstrate that only one of the two strands of a bacterial DNA is able to give a complex with ribosomal RNA. These observations are done on a new kind of hybrid molecule, which is formed at room temperature, between one, well defined, strand of DNA, and ribosomal RNA fragments. The properties of the complex are studied, and the DNA strand not involved in the formation of the complex is isolated by a chromatographic procedure; its inability to renature with itself is verified. Author

N65-29243# Rochester Univ., N. Y.
MITOCHONDRIA AND RADIATION SENSITIVITY OF CELLS
E. Tsinga and G. W. Casarett 19 Jul. 1965 77 p refs
(Contract W-7401-ENG-49)
(UR-666)

Albino male rats were exposed to 600 r total-body irradiation and sacrificed thereafter at various time intervals up to 40 days. Samples of pancreas, intestine, thymus, liver, kidney, adrenal and testis were prepared for histopathological and mitochondrial study by means of the optical-microscope. Globulation, clumping and disappearance of the mitochondria were observed in the degenerating radiosensitive cells of the intestine, thymus, and testis after irradiation. No changes in the morphology, number, or distribution of the mitochondria were detected in the radioresistant parenchymal cells of the pancreas, liver, kidney, and adrenal, or other radioresistant cells in any of the organs studied. It was concluded that mitochondrial morphology was relatively resistant to the actions of x-rays and that the effects observed were not specific for irradiation but secondary to other injuries in cells. Author

N65-29246# Joint Publications Research Service, Washington, D. C.
THE EFFECTS OF CLIMATIC CONDITIONS ON CHRONIC IRRADIATION BY SUPERHIGH-FREQUENCY ENERGY
A. Ya. Loshak 28 Jul. 1965 9 p refs Transl. into ENGLISH from Gigiyena i Sanit. (Moscow), no. 6, Jun. 1965 p 18–22
(JPRS-31280; TT-65-31777) CFSTI: $1.00

A comparative physiological examination of a large group of persons working under conditions of hot and temperate climate was made to determine the effects of climatic conditions on chronic irradiation by centimeter waves with a flux density from units of a microvolt to several hundred microvolts per sq cm for one to six hours per day. It was observed that irradiation under hot climate conditions produces more frequent and pronounced functional changes in the individual than under temperate climate conditions. The nervous system is the most sensitive to the combined effects of microwaves and high temperature. It was concluded that to prevent the appearance of changes in the state of health of personnel of installations in the hot climate areas professional screening in the assignment and acceptance for this work must be carried carefully; medical examinations should be conducted no less than twice a year; and strict observance of the requirements of safety techniques and industrial sanitation should be observed. E.E.B.

N65-29348 Joint Publications Research Service, Washington, D. C.
STUDIES ON MUTUALLY INHIBITORY RETINAL TRANSIENT REACTIONS
Yun-Chiu Wang, Chu-Ying Cheng, and Hui-Ling Hou *In its* Transl. on Communist China's Sci. and Technol. No. 196 12 Jul. 1965 p 33–37 refs (See N65-29342 18-34) CFSTI: $3.00

A study of the transient mutually–inhibiting retinal reaction is presented. An approximating formula is derived for the computation of the retinal transient reactions. Results computed from the equation of the transient reaction are compared with physiological collected data. N.E.A.

N65-29373*# Texas Woman's Univ., Denton. Nelda Childers Stark Lab. for Human Nutrition Research.

FUNDAMENTAL INVESTIGATION OF LOSSES OF SKELETAL MINERAL IN YOUNG ADULT HUMAN MALES AND COLLATERALLY IN YOUNG ADULT MALE PIGTAIL MONKEYS (MACACUS NEMESTRIMA) THROUGH IMMOBILIZATION FOR VARYING PERIODS OF TIME, COUPLED WITH A STUDY OF METHODS OF PREVENTING OR REDUCING MINERAL LOSS

Pauline Beery Mack, Betty Bohon Alford, Ralph E. Pyke, Arcienegas Klapper, Sue Nell English et al 31 Mar. 1965 55 p refs

(Grant NsG-440)

(NASA-CR-63993) CFSTI: HC $3.00/MF $0.50 CSCL 06E

A discussion of two 14-day bed rest studies, including collateral ambulatory pre-bed rest and post-bed rest periods, is presented. In the first study four subjects were fed a basic diet which provided 2.0 grams of calcium per day during pre-bed, and post-bed rest periods. The subjects respectively lost 3.86, 3.00, 6.50, and 6.48 percent of bone mass during bed rest. They had a mean overall daily calcium balance of −0.257, −0.320, −0.293, and −0.205 grams, respectively. In the second study five subjects were daily fed 0.5 grams of calcium during bed rest after they had been equilibrated on a diet which provided 1.5 grams of calcium per day. During bed rest the subjects did not consume all of the food offered them, rejecting chiefly some of the bread. As a result they consumed a mean ranging from 0.395 to 0.466 grams of calcium daily. This group was in marked negative calcium balance with mean daily calcium balance values ranging from −0.507 to −0.813 grams. R.N.A.

N65-29381*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

VISUAL MASKING USING DIFFERENT TEST STIMULUS PATTERNS

Robert C. Boyle [1964] 20 p refs Presented to Armed Forces–NRC Comm. on Vision, Washington, 23–24 Apr. 1964

(NASA-TM-X-51978) CFSTI: HC $1.00/MF $0.50 CSCL 06P

Visual masking is defined as the gradual reduction of correct responses to the orientation of a patterned test stimulus as the temporal interval between the test stimulus and a succeeding brighter masking stimulus is decreased. To indicate the test stimulus direction, a four-position response switch was activated which stopped the timing counter and initiated the stimulus repositioning. The preselected stimulus position, and response latency were printed out on the digital printer. It was determined that a value of 28.6 milliseconds would be the minimum latency of a visual evoked potential for a bright stimulus which filled the entire eye. It was concluded that these latencies could have important ramifications for the operation of high velocity spacecraft, and, in cases of the extreme velocities associated with space flight, traditional concepts of pilot observation of the external environment will require modification. R.W.H.

N65-29386*# Yeshiva Univ., New York.

TOTAL ADAPTATION TO PRISMATIC DISPLACEMENT IN THE ABSENCE OF REAFFERENCE

Sidney Weinstein, Eugene A. Sersen, Marvin Weisinger, Larry Fisher, and Milton Richlin [1964] 8 p refs

(Grants NsG-489; VRA-RD-427)

(NASA-CR-58609) CFSTI: HC $1.00/MF $0.50 CSCL 06P

A study was conducted to determine whether 100% adaptation to prismatic displacement can be achieved without any bodily movements. Such compensation was demonstrated by 8 out of 46 subjects. An analysis of variance was performed for each subject comparing his preexposure and postexposure mean with zero per cent adaptation (preexposure mean) and with 100% adaptation (preexposure mean plus 7.42°). In addition to the 8 subjects reaching 100% adaptation, 15 subjects achieved adaptation which was significantly greater than zero, ranging from 18% to 90%. Of these 15 subjects, 4 achieved adaptation which did not differ significantly from 100%. All 15 subjects who achieved positive adaptation did so within three ten-minute exposure periods, 6 within the first trial. Of the 8 subjects who achieved 100% adaptation, two each achieved it within trials two, three, four, and five. Of these 8 subjects, 7 achieved significant positive adaptation by the first trial, and the other by the third trial. R.N.A.

N65-29387*# Kaiser Foundation Research Inst., Richmond, Calif.

SPECIFIC NUCLEOSIDE TRIPHOSPHATASES IN CRUDE EXTRACTS OF *ESCHERICHIA COLI*

I. D. Raacke [1964] 30 p refs Submitted for Publication Prepared in Cooperation with Calif Univ., Berkeley

(Grants NsG-479; NSF G-19532; NIH GM-07924-02)

(NASA-CR-59104) CFSTI: HC $2.00/MF $0.50 CSCL 06M

The distribution and general properties of nucleoside triphosphatases in crude extracts of *Escherichia coli* were studied. All four triphosphates studied were hydrolyzed by the extracts. The rate of release of inorganic phosphates is highest from ATP, followed by CTP, GTP, and UPT. From 80% to 90% of the total enzyme activities are sedimentable in a sucrose density gradient. The specific activity (per mg protein) is highest in the polysome fraction. The enzymes can be released from the polysomes by treatment with ribonuclease in the cold. The distribution of each activity is affected in a different way by variations of pH and salt concentration in the extraction buffer or the gradient, showing that four triphosphatases are involved. The enzymes have an alkaline pH optimum, require Mg^{++} for maximum activity, are not inhibited by fluoride and azide, and are not stimulated by dinitrophenol, Na^{+}, K^{+}, or amino acids. Correlation of the enzyme activity peaks for the four substrates throughout the gradient showed that they do not coincide with each other. CTPase is not bound to the same macromolecular component as ATPase and GTPase. R.N.A.

N65-29388*# Kaiser Foundation Research Inst., Richmond, Calif.

DIFFERENTIAL DISTRIBUTION OF RNA AND PROTEIN IN THE RIBOSOMAL FRACTIONS OF *ESCHERICHIA COLI*

I. D. Raacke [1964] 28 p refs Submitted for Publication Prepared in cooperation with Calif. Univ., Berkeley

(Grants NsG-479; NSF G-19532)

(NASA-CR-59068) CFSTI: HC $2.00/MF $0.50 CSCL 06A

The RNA to protein ratio profiles of sucrose density gradient-separated crude extracts and ribosomal preparation of *E. coli* were used to study the homogeneity of ribosomes, and to determine the effects of buffer salts, pH, ribonuclease treatment, and differential centrifugation on all ribosomal components. Different RNA to protein ratios were obtained for different components in the ribosomal region of the gradient. The ratios were always highest in the 70s or 100s components and

lower in the polysome region. The ratio profile in the ribosomal region showed well defined and periodically spaced peaks, indicating the presence of protein rich and protein poor components within each sedimentation class of ribosomes. Peak heights in the ratio profile and the difference in protein content between the polysome region and the main peak were largest in crude extracts, and became attenuated in the course of purification of the ribosomes. The profiles provide a sensitive analytical test for homogeneity of ribosomes and permit detection of subtle changes in the components of a preparation. R.N.A.

N65-29416*# Chicago Univ., Ill.
ELECTRON MICROSCOPIC AND BIOCHEMICAL STUDIES OF PYRUVATE DEHYDROGENASE COMPLEX OF ESCHERICHIA COLI
Humberto Fernandez-Moran, Lester J. Reed, Masahiko Koike, and Charles R. Willms (Texas Univ., Austin) 26 Jun. 1964 14 p refs Submitted for Publication
(Grant NsG-441)
(NASA-CR-58980) CFSTI: HC $1.00/MF $0.50 CSCL 06M

Examination of the Escherichia coli pyruvate dehydrogenase complex and its component enzymes in the electron microscope indicates that the complex has a polyhedral structure with a diameter of about 300 to 350 Å and a height of 200 to 250 Å. The lipoic reductase-transacetylase aggregate, consisting of about 64 subunits, occupies the central portion of the polyhedron and has the appearance of a tetrad of 130 to 150 Å. Surrounding this tetrad are about 16 molecules of pyruvate decarboxylase and about 8 molecules of dihydrolipoic dehydrogenase arranged into two rings laid one above the other. The sequence of these latter molecules cannot yet be specified. However, many of these molecules are similar in appearance and dimensions (70 to 90 Å) to those observed in electron micrographs of the isolated pyruvate decarboxylase component of the complex. The reconstituted complex closely resembles the native complex in appearance. Author

N65-29450*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CONVERSION OF ACETATE TO LIPIDS AND CO_2 BY LIVER OF RATS EXPOSED TO ACCELERATION STRESS
D. D. Feller and E. D. Neville [1963] 18 p refs Submitted for Publication
(NASA-TM-X-51940) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Male Sprague-Dawley rats in age groups from 1 to 20 weeks were centrifuged at 4.5 g for periods of 0.5 hr to 14 days. Slices of liver, kidney, and inguinal adipose tissue were incubated with C^{14}-labeled acetate, and the resulting CO_2 and lipids were measured. When compared with controls liver and adipose tissue from nonfasted centrifuged rats showed an increased formation of C^{14}-lipids while kidney showed a decrease. Liver from fasted centrifuged rats also showed an increased formation of C^{14}-lipids when compared to the fasted noncentrifuged controls. The increase in acetate conversion varied with age of animal and duration of exposure. No significant change in C^{14}-acetate oxidation was noted in either fed or fasted centrifuged animals as compared to their corresponding controls. The total lipid content of the tissues from centrifuged rats was generally lower than in the controls and was also a function of age of the animal and time of exposure. Author

N65-29471*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VOLUNTARY DEHYDRATION
John E. Greenleaf [1964] 70 p refs Submitted for Publication
(NASA-TM-X-51938) CFSTI: HC $3.00/MF $0.75 CSCL 06P

In this study of the physiology of thirst and drinking, the literature on the lag in rehydration following water loss in man and other animals is reviewed. This lag is termed voluntary dehydration. While most animals rehydrate fairly rapidly, the rat and man do not. Man requires 24 hours or longer to regain a water deficit of six percent of his body weight, whereas most other animals can do it in one hour or less. Man regains the lost water at a constant rate, and cannot force down water beyond one liter without inducing vomiting. There are many factors which influence the physiology of drinking, and attempts to explain the phenomenon on the basis of a single factor have not been successful. There is a need for research on the relationships among the many variables applicable to water metabolism and to determine how they are related to the time factor in drinking. J.M.D.

N65-29485*# Kaiser Foundation Research Inst., Richmond, Calif. Lab. of Comparative Biology.
FATE OF SPECIFIC RIBONUCLEOSIDE TRIPHOSPHATASES ON PURIFICATION AND RECONSTITUTION OF THE RIBOSOMAL SYSTEM OF ESCHERICHIA COLI
I. D. Raacke and J. Fiala [1964] 72 p refs Submitted for Publication Prepared in Cooperation with Calif. Univ., Berkeley
(Grants NsG-479; NSF G-19532; NIHGM-07924-02)
(NASA-CR-59029) CFSTI: HC $1.00/MF $0.50 CSCL 06M

The relative changes in RNA, protein, and four triphosphatases, which occurred when a crude extract of *E. Coli* was separated into ribosomal and supernatant fractions, and when the purified ribosomes recombined with the supernatant, were investigated. It was shown that the protein and the RNA were mainly lost from the heavy and light particle fractions. The relative loss of protein was greater than RNA as shown by the increased RNA to protein ratio of the ribosomes, as compared to the crude extract. It was noted that the enzyme peaks in the purified ribosomes were sharper than those in the crude extract, showing that the ribosomes remain heterogeneous after purification. The specific activity of the enzymes was highest in the heavy regions of the gradient, the same as in the crude extracts, and low in the main peak. Most of the low triphosphatase activity in the supernatant was due to small amounts of incompletely sedimented particles. It was concluded that many possible and previously unrecognized differences exist between ribosomal preparations which were identical by conventional sucrose density gradient analysis. R.W.H.

N65-29487*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF WEIGHTLESSNESS ON MAN DURING U.S. SUBORBITAL AND ORBITAL FLIGHTS
Siegfried J. Gerathewohl [1963] 43 p refs
(NASA-TM-X-51935) CFSTI: HC $2.00/MF $0.50 CSCL 06S

The astronauts' responses to weightlessness during the Project Mercury flights are analyzed. All abnormalities attributed to weightlessness during the flights were well within the tolerance limits of the human organism. Consistent trends in response changes during the flights were best reflected by the vital signs. Cardiovascular, pulmonary, and metabolic changes were found which may be associated with weightlessness. A correlation between duration of weightlessness and response change in cardiac and respiration rates during reentry stress is apparent. There are no psychological or physiological contra-indications to embarking on longer spaceflight missions, but the adverse effects of orthostatic hypotension and orthostatic tachycardia—observed after the longest flights—should first be investigated in a manned earth orbiting laboratory. J.M.D.

N65-29623*# National Aeronautics and Space Administration, Washington, D. C.

PHYSIOLOGICAL EFFECTS OF GRAVITATION [FIZIOLOGICHESKIYE EFFEKTY GRAVITATSII]

O. G. Gazenko and A. A. Gyurdzhian Aug. 1965 23 p refs Transl. into ENGLISH of a paper presented at the 8th Plenary Meeting and 6th Intern. Space Sci. Symp., Buenos Aires, 10-21 May 1965

(NASA-TT-F-376) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The physiological effects of weightlessness are discussed, as they were measured and reported by the Russian cosmonauts. The possibilities of adaptation to space environment by training and the mechanisms of compensation and vicarization (adaptive substitution) of the analyzers and processes of the biological entity are considered. The authors present recommendations for cosmonaut training for distant and prolonged flights. Author

N65-29648*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography

May 1965 163 p refs

(NASA-SP-7011(11)) CFSTI: HC $1.00/MF $1.00 CSCL 06S

Annotated references are presented, which concentrate on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References to articles describing similar effects on biological organisms of lower order are also included. Related topics such as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development are also listed. C.T.C.

N65-29649*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography

Jun. 1965 109 p refs

(NASA-SP-7011 (12)) CFSTI: HC $1.00/MF $0.75 CSCL 06E

Aerospace Medicine and Biology is a continuing bibliography which, by means of periodic supplements, serve as a current abstracting and announcement medium for references on this subject. The subject coverage concentrates on the biological, physiological, psychological, and environment effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general emphasis is placed on applied research, but reference to fundamental studies and theoretical principles related to experimental development are also included. The contents of this issue are comprised of abstracts that were prepared by NASA, AIAA, and The Library of Congress (LC). N.E.A.

N65-29650*# Stanford Univ., Calif. Dept. of Genetics.

PROTON MAGNETIC RESONANCE SPECTRA OF SOME PROTEINS, I RIBONUCLEASE, OXIDIZED RIBONUCLEASE, LYSOZYME AND CYTOCHROME C

Morton Mandel [1965] 22 p refs Submitted for Publication

(Grant NsG-81)

(NASA-CR-58662) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Proton magnetic resonance spectra of twenty common amino acids and some representative di- and tripeptides obtained at a fixed frequency of 100 Mc are presented. The effect of peptide bonds on chemical shifts, and steric conformational changes are discussed. Tables showing the chemical shifts of amino acid protons in D_2O, and the chemical shifts of amino acid protons in peptides with respect to the corresponding group in the free amino acid are given. NMR spectra are shown for ribonuclease, oxidized ribonuclease, lysozyme, and cytochrome C. L.S.

N65-29652*# Brandeis Univ., Waltham, Mass. Dept. of Biochemistry.

USE OF QUANTITATIVE MICRO-COMPLEMENT FIXATION FOR DETECTION OF SMALL DIFFERENCES IN PROTEIN STRUCTURE

Morris Reichlin, Allan C. Wilson, and Lawrence Levine [1965] 16 p refs

(Grant NsG-375)

(NASA-CR-58660) CFSTI: HC $1.00/MF $0.50 CSCL 06A

Three techniques (the quantitative precipitin reaction, macrocomplement fixation and micro-complement fixation) have been compared for their capacity to distinguish chicken from turkey H_4 lactic dehydrogenase, human from chimpanzee serum albumin, and chicken from turkey ovalbumin. With each immune system, greater serological differences were found by micro-complement fixation. It is suggested that the greater sensitivity exhibited by micro-complement fixation may reflect the measurement of a more avid fraction of the antibody population. Hence, even a slightly different conformation in a heterologous antigen might be expected to lead to dissociation of the antigen-antibody aggregates that are required for complement fixation. Author

N65-29726*# National Aeronautics and Space Administrstion, Washington, D. C.

THE EFFECT OF DIETETIC MEASURES ON THE OSMOTIC BALANCE OF THE BLOOD IN NORMAL PERSONS, PART 1 [UBER DEN EINFLUSS DIATETISCHER MASSNAHMEN AUF DAS OSMOTISCHE GLEICHGEWICHT DES BLUTES BEIM NORMALEN MENSCHEN, 1 MITTEILUNG]

Anton Regnier Jul. 1965 46 p refs Transl. into ENGLISH from Z. Expti. Pathol. und Therap. (Berlin), v. 18, 1916 p 139-164

(NASA-TT-F-9439) CFSTI: HC $2.00/MF $0.50 CSCL 06P

A one-time increase in salt intake without increased water intake combined with a normal diet, leads either to a temporary rise in the molecular concentration of the blood which is partially determined by the influx of achloride mineral constituents, or to protracted hydremia with a delayed elimination of table salt. With a concurrent restriction of the water intake, an initial disturbance of the isotonicity of the blood may occur since the appropriate quantities of the water are not replaced rapidly enough by the cellular fluid deposits. A one-time increase in water consumption leads to an increased elimination of NaCl and N. An increased fluid consumption over a period of 11 days causes relatively more water to be excreted through the kidneys and less by extrarenal routes. In this case, the blood thickens and its molecular concentration increases. The kidneys do not lose their normal concentration capacity. During a salt-poor diet an increase in extrarenal elimination may occur. In the observed case, the blood thickened and the molecular concentration increased. N.E.A.

N65-29740*# National Aeronautics and Space Administration, Washington, D. C.
DATA PROCESSING SYSTEMS IN SPACE BIOLOGY [AVTOMATICHESKIY KONTROL' I METODY ELEKTRICHESKIKH IZMERENIY]
R. M. Bayevskiy, A. D. Voskresenskiy, O. G. Gazenko, A. D. Yegorov, N. A. Chekhonadskiy et al Jun. 1965 9 p refs Transl. into ENGLISH from Tr. IV Konfi, v. 2, 1962 Redaktsionnoizdatel'skiy Otdel Sibirskogo Otdeleniya An SSSR (Novosibirsk), 1964 p 100–105
(NASA-TT-F-9514) CFSTI: HC $1.00/MF $0.50 CSCL 06B

Changes in the needs of experimental information and the use of data processing, especially probability-statistical methods, are discussed. A differentiation is made between investigative and control systems of data processing in relation to unique space biology conditions, with Vostok flights used as examples. Progress is also reported on automating information analysis, such as expressing biological indicators by mathematical equations. Present needs and corrections in such areas of space biology as information theory are discussed. C.T.C.

N65-29754 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN IMPROVED TECHNIQUE FOR HANDLING INJURED PERSONS IN THE WATER
Richard A. Pollard and Glenn A. Shewmake *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 20–23 (See N65-29750 18-05)

A rescue technique, using the standard Stokes litter, is described for rapid on scene assistance following a parachute landing in water and allows for the possibility of broken bones. The Stokes litter provides excellent immobilization and is large enough to accommodate a man clothed in full pressure garment. There is no need to move the patient from the litter until he is within the hospital. Pneumatic cells, selectively inflated, have been added to supoort the head and limbs in water and to provide a platform for first aid. The inflation cells uninflated and stowed have little weight and bulk and do not interfere with the use of the litter as a standard Stokes litter. After being secured to the litter by a rescue team, the patient is recovered by helicopter and transported to a medical facility. R.N.A.

N65-29758 Air Force Dept., Norton AFB, Calif. Life Sciences Div.
SURVIVAL FOLLOWING AIR FORCE AIRCRAFT ACCIDENTS, 1 JANUARY 1958–31 DECEMBER 1963
William R. Detrick and Anchard F. Zeller *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 58–72 (See N65-29750 18-05)

A study was conducted to determine survival problems following aircraft accidents. Approximately 10% of the accidents studied resulted in a survival situation. With the exception of the first few minutes in a water situation, survival for most crew members was not an insurmountable problem. The total number of accidents has diminished but the number of survival accidents remains constant. In most accidents adequate equipment was provided but too often it failed or was lost when needed. In rescue, the most difficult problem was in locating downed crewmen. Location aids, other than visual devices, have so far proven unsatisfactory. Flotation devices are considered essential for survival in water accidents. R.N.A.

N65-29760 Federal Aviation Agency, Oklahoma City, Okla. Civic Aeromedical Research Inst.
SURVIVAL OF HIGH VELOCITY FREE-FALLS IN WATER
Richard G. Snyder *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 97–117 refs (See N65-29750 18-05)

Forty-four cases of free-falls survived by individuals impacting water environments under conditions of high velocity (50 ft/sec. to 116 ft/sec., corrected for aerodynamic drag) have been intensively investigated and analyzed. Ages varied from 7 to 80 years and the study included 34 males and 10 females. The falls occurred in 17 states, mainly over a three year period, and included all known survivals of water impact at over 50 ft/sec. It was found that the most survivable body orientation, by a factor of 5–7 times, is a feet-first impact in which critical velocity for human survival was approximately 100 ft/sec. No correlation of velocity with degree of injury was found, although distinct patterns of injury were shown. Factors believed to influence human survival tolerances are discussed. Author

N65-29773*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
[INVESTIGATIONS IN SPACE-RELATED BIOLOGY] First Annual Report
1 Jun. 1965 97 p refs
(Grant NsG-689)
(NASA-CR-64060) CFSTI: HC $3.00/MF $0.75 CSCL 06A

Research progress in space related biosciences is reported on evolution of chymotrypsin and trypsin, extraterrestrial macromolecular sampler, the origin of optical activity from physical particles, optical resolution of an amino acid by a stereoselective Ligand exchange reaction, optical resolution of DL-aspartic acid, DL-glutamic acid, DL-asparagine or DL-glutamine by inoculation, formation of amino acids by pyrolysis of ammonium formate or formamide, synthesis of alpha-amino acid menthyl esters, analysis of proteinoid synthesized in presence and absence of terrestrial crustal materials, heterogeneity of thermal proteinoids, catalytic activity of hematin, catalytic activity in proteinoids, nutritive quality of thermal and Leuchs proteinoids, phosphorylation of nucleosides, thermal oligonucleotides, ultraviolet photomicrographic evidence for a membrane in proteinoid microspheres, catalytic activity and polynucleotide in proteinoid microspheres, and concepts relative to the thermal theory of origins. Also included are ultrastructural, biochemical, and immunochemical studies on marine invertebrate gametes, and sperm-egg interaction and physiological studies on gamete interaction in alga, *Chlamydomonas*. R.N.A.

N65-29790# Joint Publications Research Service, Washington, D. C.
GROWTH OF SOME MYCOBACTERIA ON PETROLEUM AND PETROLEUM PRODUCTS
I. T. Nette, N. N. Grechushkina, and I. L. Rabotnova 2 Aug. 1965 13 p refs Transl. into ENGLISH from Prikl. Biokhim. i Mikrobiol. (Moscow), v. 1, no. 2, Mar.–Apr. 1965 p 167–174
(JPRS-31360; TT-65-31857) CFSTI: $1.00

The isolation and identification of cultures of microorganisms that actively utilize petroleum products, and the possibility of their growth on various concentrations of oils and fuels and on individual hydrocarbons were studied. Most of the cultures identified were mycobacteria which actively used hydrocarbons; these predominated in all cases. Experiments showed that petroleum and petroleum products are most actively utilized by cultures of *M. mucosum*, *M. lacticolum*, and three strains of bacterium. Most of the isolated strains grew on the C_1-C_4, C_6-C_{10}, C_{12}, and C_{16} alkanes. On oils without an aqueous medium with mineral salts, the microorganisms did not grow. It was shown that *M. mucosum* and *M. lacticolum* can use all fractions of paraffin petroleum boiling at 122° to 500° F. C.T.C.

N65-29820*# Texas Inst. for Rehabilitation and Research, Houston.

THE EFFECT OF BEDREST ON VARIOUS PARAMETERS OF PHYSIOLOGICAL FUNCTION. PART VI: THE EFFECT OF THE PERFORMANCE OF PERIODIC FLACK MANEUVERS ON PREVENTING CARDIOVASCULAR DECONDITIONING OF BEDREST

Fred B. Vogt, David Cardus, Carlos Vallbona, and William A. Spencer (Baylor Univ. Coll. of Med.) Washington, NASA, Jul. 1965 41 p refs

(Contract NAS9-1461)

(NASA-CR-176) CFSTI: HC $2.00/MF $0.50 CSCL 06E

Six subjects participated in two 3-day bedrest periods: the first period consisted of bedrest alone, the second period consisted of bedrest plus periodic Flack maneuvers, and the periods were separated by 4 days to allow for recovery. At the end of the first period, 3 of 6 subjects experienced convulsive syncope while performing the Flack maneuver in the 70 degree tilt position. The subjects had not recovered at the start of the second period of bedrest. Repeated Flack maneuvers during bedrest did not prevent manifestation of orthostatism found with bedrest. Author

N65-29832# Joint Publications Research Service, Washington, D. C.

AN EXPERIMENTAL PSYCHOLOGICAL STUDY OF SKILLED ATHLETES WITH USE OF THE CONTROLOGRAPH

Ya. I. Tsurkovskiy 2 Aug. 1965 10 p refs Transl. into ENGLISH from Probl. Psikhologii Sporta (USSR), no. 1, 1960 p 254–260

(JPRS-31374; TT-65-31871) CFSTI: $1.00

Data collected from laboratory experiments, objective observations, word surveys, and subjects' efforts are combined to study skilled athletes by use of a controlograph. The athlete-subject is required to perform specified tasks in two different ways, and he is required to monitor himself after he becomes familiar with the controlograph. Indices for various tasks are presented in tabular form, and it is concluded that the proposed method can be applied for the psychological diagnosis of athletes in various fields. The data indicate that systematic sports exercises favor a broad development of the mental processes and develop capacity for self-control to insure success in sports activity. Further, it is stated that these results support the position that the motor habits of an athlete are formed consciously. While such a systematization is considered somewhat schematic in character, it is felt that the controlograph study can establish interrelationships between temperaments and controlability for subgroups of athletes. M.W.R.

N65-29855# European Atomic Energy Community, Brussels (Belgium).

STUDY ON THE IDENTIFICATION METHODS OF IRRADIATED FOODSTUFFS

A. Lefontaine and L. Bugyaki Apr. 1965 33 p refs

(EUR-2402.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 50 Belg. Fr.

After a brief review of the economic and health considerations involved in the preservation of foodstuffs, the authors mention the various methods generally used and set out the principles which led to the proposal to use ionizing radiations for this purpose. The authors point out that uncertainty as to the wholesomeness of irradiated foods still exists in scientific circles in spite of extensive research. Nevertheless, certain countries have already permitted several kinds of irradiated food to be distributed for consumption. There are grounds to expect that the marked zone for certain of these products will not stop at the national frontiers. The problem therefore arises, of how to identify irradiated products and how to ascertain the dose employed for irradiation, if any. The methods suitable for such a purpose include measurement of the paramagnetic state of the atom, electrophoresis, measurement of the oxido-reduction potential, polarography, chromatography, spectrophotometry, colorimetry, microscopic examination of the tissues, immunological changes, microbiology, deterioration of the packaging and changes in the organoleptic characteristics. Author

N65-29880# Medical Research Council, London (England).

ASSAY OF STRONTIUM-90 IN HUMAN BONE IN THE UNITED KINGDOM. PART I: RESULTS FOR 1964

Lord Shawcross et al Feb. 1965 18 p refs

(Rept.-10) HMSO: 1s 9d

The results of assays of strontium 90 in samples of human bone from subjects who died in the first half of 1964 are presented as part of a survey on the effects of radioactive fallout. Details of the bone samples and the assay results are tabulated. Minimum, maximum, median, and mean Sr^{90} values for four age groups—newborn, 0 to 4 years, 5 to 19 years, and 20 years and over—were compared with values for 1963. The values were higher in the first three age groups with a considerable increase in the 0 to 4 year group. R.N.A.

N65-29879# Joint Publications Research Service, Washington, D. C.

PHARMACOLOGY AND TOXICOLOGY—1962

S. P. Yarmonenko, V. S. Shashkov, and R. Kostyanovskiy 2 Aug. 1965 29 p Transl. into ENGLISH from Farmakol. i. Toksikol. 1962 (Moscow), 1964 p 110–136

(JPRS-31349; TT-65-31846) CFSTI: $2.00

Chemical preparations for radiation protection are surveyed and analyzed. Included are discussions on the classification of these agents; the various protection mechanisms including protection by inactivation of free radicals, by a physicochemical change in the biosubstrate molecules, and by the oxygen effect; model systems; mercaptoalkylamines, indolylalkylamines, and other miscellaneous radioprotective compounds; the combined use of radioprotectors; inhibitors of free radical reactions; and the practical aspects of using antiradiation preparations. R.N.A.

N65-29883# Inter-American Nuclear Energy Commission, Washington, D. C.

5th INTER-AMERICAN SYMPOSIUM ON THE PEACEFUL APPLICATION OF NUCLEAR ENERGY

1965 274 p refs Symp. held at Valparaiso, Chile, 9–13 Mar. 1964; Sponsored in cooperation with Govt. of Chile and U. S. AEC

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N65-29886# Rochester Univ., N. Y. Medical Div.

THE EFFECT OF WIDE X-RAY BEAM AND FINITE PHANTOM THICKNESS ON 1000 KVP X-RAY DEPTH DOSE

H. D. Maillie and H. Mermagen Aug. 1965 23 p refs

(Contract W-7401-ENG-49)

(UR-687) CFSTI: $1.00

Pseudo-infinite phantom dose measurements were made over a field for studying the effect of wide X-ray beam and phantom thickness on 1000 KVP X-ray dose, to improve the dose accuracy in X-irradiation of animals. Normally the dose is estimated by extrapolation from available dose tables. It was found that depending upon the field area and the thickness of the tissue-like mass involved, an exit surface dose will be considerably lower than the dose at a similar depth within a semi-infinite phantom. In determining the center-beam depth dose, it was demonstrated that errors of as much as 30% low may be incurred if such doses are derived from published depth dose tables. Data are presented in tabulated and graphic form. L.S.

N65-29915# Kansas Univ., Kansas City. Dept. of Physiology.
CARBON DIOXIDE, OXYGEN, AND ACIDITY—THE INTERACTION AND INDEPENDENT EFFECTS ON BREATHING OF THESE FACTORS IN THE ARTERIAL BLOOD Final Report, Aug. 1961–Aug. 1963
Robert William Hamilton, Jr. and E. B. Brown, Jr. Brooks AFB, Tex., AF School of Aerospace Med., Dec. 1964 47 p refs
(Contract AF 41(657)-400)
(SAM-TR-64-94; AD-462984)

Experiments were conducted on pentobarbital anesthetized dogs and on trained unanesthetized dogs to determine the independence or degree of interaction among the three chemical stimuli: O_2, CO_2, and H^+ (measured in arterial blood) as respiratory stimulants. The interaction of the $CO_2 - H^+$ complex and low oxygen, as described by others, was reconfirmed. Further dissection of this relationship indicated that the interaction is between CO_2 and O_2 and the H^+ is not involved. The interaction of CO_2 and H^+ was determined with oxygen tension held above 200 mm. Hg, at which level it is unimportant as a respiratory stimulant. It appears that the response to CO_2 decreases as the level of H^+ increases and vice versa. We interpret this as a negative interaction between these two chemical agents. Author

N65-29924# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
PROTON ABSORPTION IN DOSE-EQUATED MATERIALS Technical Report, 1 Sep.–1 Dec. 1964
Joseph F. Janni Apr. 1965 185 p refs
(AFWL-TR-65-3; AD-616703)

This report presents theoretically calculated values of the ionization interaction for protons in numerous materials and compares these values with those of tissue and bone. This has been done so that possible dosimetric media may be compared and evaluated for "dose equivalency." Results for the linear energy transfer have also been included. The proton energies are considered from .5 Mev. to 1000 Mev. The K and L shell effects upon the stopping power equation have been included. The calculation approach and the resultant tabulations are presented in detail for over seventy different materials. Author

N65-29998# Air Force Systems Command, Kirtland AFB, N. Mex. Air Force Weapons Lab.
X-RAY ABSORPTION IN DOSE-EQUATED MATERIALS Technical Report, 1 Jan.–1 Jun. 1964
Benton C. Clark and Joseph F. Janni May 1965 152 p refs
(WL-TR-64-134; AD-616773)

The calculated values and comparisons of X-ray interaction parameters for a number of materials are presented so that possible dosimetric media may be directly compared and evaluated with several selected radiation effects media. The photon energies considered range from 0.01 Mev to 100 Mev. The calculational approach as well as the resultant tabulations are presented in detail. Author

N65-30015# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHANGES IN THE ELECTROENCEPHALOGRAM AND DERMA-GALVANIC REACTIONS IN THE PROCESS OF FORMATION OF TENTATIVE RELATIONSHIP BETWEEN MOTORIAL AND VISUAL ANALYZERS IN HUMANS
V. M. Vasil'yeva 3 Jun. 1965 15 p refs Transl. into ENGLISH from Zh. Vysshei nervnoi Deyatel'nosti (Moscow), v. 14, no. 5, 1964 p 755–762
(FTD-TT-65-434/1+2; AD-615995)

A pairing was made of the kinesthesic and photo stimulations in man with a view to forming a temporary connection between the motor and visual analysers. Proprioceptive stimulation was achieved by the movement of the muscles, provoked by stimulation of the ulnar nerve through the skin by threshold impulses of a rectangular current not accompanied by tactile effect. After several pairings of the stimuli a conditioned EEG response was elaborated: the movements of the muscles resulted in the same depression of the alpha-rhythm in the occipital area as the photic stimulations paired with them. The dynamics of EEG and SGR changes in the course of formation of such a reaction is characterized by a number of regularities inherent in temporary connections between exteroceptive stimuli. Author

N65-30036# Benson (Robert W.) and Associates, Inc., Nashville, Tenn.
EXPERIMENTAL BONE AND TISSUE VIBRATOR ASSEMBLY Final Report, Jun. 1963–Aug. 1964
Robert W. Benson Wright-Patterson AFB, Ohio, AMRL, Apr. 1965 33 p refs
(Contract AF 33(657)-11335)
(AMRL-TR-65-11; AD-615916)

A special purpose laboratory vibrator has been developed for use in experimental investigations of hearing by bone and tissue conduction and of mechanical driving point impedance of tissue and bone. The vibrator assembly is floated on an air bearing to provide resonance-free operation over the frequency range of 100–10,000 cps and at intensity levels of 60 decibels above threshold of hearing. Special sensors within the unit provide measurement of the tip velocity of the alternating pressure transmitted by the head and the force due to an external load. Design features and calibration procedures are discussed in this report. Author

N65-30175# Medical Coll. of Virginia, Richmond.
ACUTE BRAIN DAMAGE INDUCED BY X-IRRADIATION. 1: CYTOCHEMICAL AND BIOCHEMICAL STUDIES OF NEUROGLIAL NUCLEIC ACIDS Final Progress Report, 23 Apr. 1964–31 Jul. 1965
Robert H. Brownson [1965] 7 p
(Contract AT(40-1)-2904)
(TID-21440)

An investigation was conducted to determine the effects of X-irradiation on certain features of DNA cytochemistry peculiar to pyknotic neurological cells. Radiated pyknotic cells of corpus callosum were found to be resistant to depolymerization of DNAase as well as to hydrolysis by HCl; the radiation-induced aggregation of DNA fluoresces a bright yellow–orange before and after treatment by these techniques. Since normal nonradiated cells do not exhibit any of these characteristics, these findings are considered to support the concept that resistance to depolymerization is due to a change in molecular configuration. Using direct tissue electrophoresis there were different patterns for control and irradiated cells, and there was a definite increase in pyknotic cells following irradiation. As the length of radiation increased, the ratio of these cells per gram of tissue decreased, perhapes indicating possible recovery of nuclei from X-ray. M.W.R.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-29160# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE DYNAMICS OF EMOTIONAL-VOLITIONAL PROCESSES DURING PARACHUTE JUMPS BY ASTRONAUTS

G. F. Khlebnikov and V. I. Lebedev 11 May 1965 16 p refs Transl. into ENGLISH from Vopr. Psikhol. (Moscow), no. 5, 1964 p 3–10
(FTD-TT-65-437/1; AD-615534)

Soviet cosmonauts were observed during preliminary parachute jumping trainings. The registration of changes of hand strength and the heart-rate disclosed the dynamics of the emotional 'tuning' of cosmonauts to the coming parachute jumpings. On the first day of parachute jumping, emotional reactions were significant and markedly different from emotional reactions of well-trained parachutists. Subsequently, the reactions became more adequate; and due to the training of volitive processes, the emotional manifestation at the repeated parachute jumpings became weak. The emotional reactions to danger are characterized by 'sthenic' excitation which is evoked by the activation of the conscious regulation of behavior. All cosmonauts had the most stable positive emotions at the second stage of parachute jumping trainings (jumping onto the water, during nights, in the diving suits). TAB

N65-29239# Autonetics, Anaheim, Calif.

LABORATORY STUDIES IN AIR-TO-GROUND TARGET RECOGNITION. V: THE EFFECTS OF AIRCRAFT SPEED AND TARGET TYPE

R. L. Calhoun and H. L. Snyder 31 May 1965 31 p refs (T5-990/3111)

A laboratory simulation experiment was performed to determine the effect of target type and ground speed on air-to-ground target recognition. The aircraft's forward view was simulated from color motion pictures obtained in flight. Examples of four target types were selected. Performance was measured in terms of probability and range of correct recognition. The average recognition range was significantly affected by target type; in spite of the initial four-type target breakdown, performance results indicated that there were only two functionally distinct types. A *post hoc* examination of target pictures suggested a possible visual basis for the performance outcomes. The problem of target classification is discussed. Author

N65-29350# Joint Publications Research Service, Washington, D. C.

CYBERNETIC AND COMPUTER TECHNIQUES AS APPLIED TO PSYCHOLOGY IN THE SOVIET UNION

13 Jul. 1965 65 p refs Transl. into ENGLISH of 7 articles from Vopr. Psikhologii (Moscow), no. 2, 1965 p 3–16, 28–34, 49–74, 173–180
(JPRS-31062; TT-65-31560) CFSTI: $3.00

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2. SELECTIVE DISTURBANCE IN SPEECH ORGANIZATION: INSTABILITY OF AUDIO-SPEECH TRACES Ye. P. Kok p 16–21 refs

3. ON A POSSIBLE APPROACH TO MODELING THE HUMAN PSYCHIC SPHERE N. M. Amosov, E. T. Golovan', S. Ya. Zaslavskiy, and V. S. Starinets p 22–28 refs (See N65-29351 18-05)

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5. DETERMINING CERTAIN SELECTED CHARACTERISTICS OF THE RESULTS OF PSYCHOPHYSIOLOGICAL EXPERIMENTS WITH THE AID OF COMPUTERS Yu. M. Baraboshkina p 40–47 refs

6. ENGINEERING PSYCHOLOGY O. A. Konopkin p 48–57

7. NEW BOOKS OF THE PROSVESHCHENIYE (ENLIGHTENMENT) PUBLISHING HOUSE p 58–61

N65-29351 Joint Publications Research Service, Washington, D. C.

ON A POSSIBLE APPROACH TO MODELING THE HUMAN PSYCHIC SPHERE

N. M. Amosov, E. T. Golovan', S. Ya. Zaslavskiy, and V. S. and V. S. Starinets *In its* Cybernetic and Computer Tech. as Applied to Psychol. in the Soviet Union 13 Jul. 1965 p 22–28 refs (See N65-29350 18-05) CFSTI: $3.00

An investigation was conducted to construct a model of the genesis and analysis of sentences, taking into account certain peculiarities of the emotional sphere and organization of human memory. During the operation of the model, elements of the input words are given certain emotions and the whole word is given some emotional state even before the input word arrives at the model. When the model has gone through a certain number of cycles, it may independently realize the indicated operations by employing a certain amount of data stored in its long term memory. R.N.A.

N65-29431*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.

HUMAN RESTRAINT SYSTEMS DEVELOPMENT FOR USE IN ACCELERATION RESEARCH

Hubert C. Vykukal and E. Gene Lyman [1964] 25 p refs
(NASA-TM-X-54780) CFSTI: HC $1.00/MF $0.50 CSCL 05E

The NASA, Ames Research Center, has a continuing need for pilot-restraint systems suitable for use in research programs designed to investigate the performance and physiological well-being of pilots during severe acceleration. Various concepts in restraint systems have been evaluated at the Ames Research Center and tested under simulated operational conditions. Based on the pilots' acceptance of these systems and on those areas requiring improvements, Ames has initiated a development contract to integrate a state-of-the-art pressure suit and a restraint system for use in full space-mission simulations. Author

N65-29605# Royal Aircraft Establishment, Farnborough (England).

THE DEVELOPMENT OF WATER CONDITIONED SUITS

D. R. Burton and L. Collier London, Min. of Aviation, Apr. 1964 26 p refs
(RAE-TN-MECH-ENG-400)

This paper presents the history of the development of a water conditioned suit, outlines the theory behind personal conditioning garments, and discusses the preliminary thoughts and work which led to the building of a first prototype suit. The results of tests on this garment are given. The events which led to the building of a second prototype, and demonstration garments, and the results obtained to date with them, are also reported. The paper concludes with a discussion on the future work it is intended to carry out in this field. Author

N65-29615# Whirlpool Corp., St. Joseph, Mich.
WATER RECLAMATION FROM URINE THERMOELECTRIC SYSTEM Final Report, May 1963–Oct. 1964
Duane C. Nichols Wright-Patterson AFB, Ohio, AMRL, Mar. 1965 21 p refs
(Contract AF 33(657)-11479)
(AMRL-TR-65-29; AD-615979)

This project was initiated to design, fabricate, and test a thermoelectric system for the recovery of potable water from urine in aerospace applications. The unit built is an integral system, which yields quality potable water at a performance factor of 146 watt-hours per pound. It has a capacity of processing 12 liters of urine per day with a batch size of 1 liter per run. Further development work should be undertaken toward obtaining better efficiencies, a decrease in size, and a reduction in weight.
Author

N65-29750# Space and Flight Equipment Association, Rolling Hills, Calif.
PROCEEDINGS OF 2ND NATIONAL FLIGHT SAFETY, SURVIVAL AND PERSONAL EQUIPMENT SYMPOSIUM
[1964] 278 p refs Symp. held at San Diego, Calif., 28–30 Oct. 1964

Symposium papers on oxygen systems and related equipment; survival, search, and rescue; escape, parachutes, and related equipment; protective clothing, restraint equipment, and safety are presented. For individual titles see N65-29751–N65-29771.

N65-29752 Sierra Engineering Co., Sierra Madre, Calif.
OXYGEN BREATHING MASKS: SELECTION, FIT, AND APPLICATION
Aaron Bloom *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 9–15 (See N65-20750 18-05)

The use of various types of oxygen breathing masks is discussed, their identification characteristics presented, hardware relationships correlated, and fit techniques and applications described.
R.N.A.

N65-29753 North American Aviation, Inc., Los Angeles, Calif.
SURVIVAL, SEARCH, AND RESCUE—OPERATION TRAINING TECHNIQUES FOR GENERAL AVIATION PILOTS AND AIRCRAFT OWNERS
Bob Minner *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 16–19 (See N65-29750 18-05)

Ideas are presented for initiating and carrying out a continuous and progressive survival program, including the problems of search and rescue; and aimed at the general aircraft owner, private pilot, and executive flight crews.
R.N.A.

N65-29755 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
FLOTATION CHARACTERISTICS OF AIRCRAFT PASSENGER SEAT CUSHIONS
Ernest B. Mc Fadden and James M. Simpson *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 24–35 refs (See N65-29750 18-05)

Various types of open cell polyether foam aircraft passenger seat cushions were investigated to determine their flotation characteristics. Seat cushions were pool tested under a static load of 14 pounds and later field tested by human subjects in light wave action. It was found that the static buoyancy testing did not simulate actual conditions of use and provided deceptive and erroneous information. In the static tests the cushions supported their loads from 18 to 60 hours while in human testing under simulated conditions the cushions provided less than 8 minutes of adequate flotation. Recommendations were made for providing a simple means of attaching the cushion to the survivor's body, and for using a combination of open and closed cell foam materials which would furnish adequate flotation with respect to quantity and duration without a sacrifice of seat cushion comfort.
R.N.A.

N65-29756 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
DEVELOPMENT OF A TRITIUM SELF-LUMINOUS LIFE RAFT LIGHT SOURCE
Ernest B. Mc Fadden, J. D. Garner, and R. A. Masler (U.S. Radium Corp., Morristown, N. J.) *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 36–51 refs (See N65-29750 18-05)

A self-luminous life raft light source designed as an aid to evacuation and life raft boarding is described and evaluated. The light source operates continuously as a result of bombardment of a phosphor by beta particles emitted by tritium gas. It does not depend on any external source of energy for illumination, is not affected by temperature extremes, and has a duration of 12.6 years. The unit is not considered a radiation hazard. When mounted parallel to the plane of the life raft tube at a position of 45 degrees from the horizontal, the source is visible through an arc in excess of 180 degrees and is therefore visible to a survivor boarding the raft from above or from the water. The source is instantly visible upon raft inflation, is not subject to activation delays or failures, is ruggedly constructed, extremely reliable, and requires no maintenance.
R.N.A.

N65-29757 Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.
DEVELOPMENT OF AN ARCTIC SHELTER
John F. Lee *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 52–57 (See N65-29750 18-05)

A program is being conducted to design and test an Arctic survival shelter having lightweight, low package volume, high thermal protection, and ease of erection. The shelter is based on the principle that the earth serves as a massive heat sink and that this heat can be trapped in an insulated fabric shelter along with the survivor's body heat to provide enough warmth for survival. Various shelter materials and designs were tested and the results are presented.
R.N.A.

N65-29759 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
LOCATION AND RETRIEVAL CONCEPTS FOR REENTRY CREW ESCAPE SYSTEMS
J. M. Peters *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 73–96 (See N65-29750 18-05)

A study is presented on location problems associated with reentry crew escape systems. The equations of motion for escape capsules having lift to drag ratios from 0.2 to 2.0 were solved to determine the ground area attainable for those capsules returning to earth from 300 mile orbits. The landing capabilities with respect to the probability of a successful recovery of the downed crew were determined. The study indicates that an escape capsule with a lift to drag ratio of 1.0 represents the simplest capsule with enough maneuvering capability to reach suitable landing areas. An escape concept is presented, emphasizing that the successful conclusion

of escape requires the determination of the necessary maneuver to reach a desirable landing area, the physical execution of that maneuver, and the transmission of escape information to recovery forces. R.N.A.

N65-29761 Weber Aircraft Corp., Burbank, Calif.
THE F-106 OPERATIONAL ZERO ALTITUDE–ZERO VELOCITY ESCAPE SYSTEM
E. L. James and W. F. Ziegler *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 118–122 (See N65-29750 18-05)

The development of a reliable zero air speed, zero altitude ejection seat for the F-106 jet aircraft is discussed. An injection system is described which employs a cartridge actuated drogue gun to ballistically eject the pilot chute and much of the main canopy thus reducing the parachute deployment time. In rocket sled tests the ejection seat equipped with the gun deployed parachute system qualified with successful performances at velocities ranging from 90 to 450 knots. The ejection system, while lacking the sophistication and supersonic capability of conventional systems, offers true zero zero capability with a high level of reliability rarely attained in ejection seats. R.N.A.

N65-29768 Gerry Mountain Sports, Inc., Denver, Colo.
COLD WEATHER SURVIVAL CLOTHING
Robert W. Swartz *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 223–224 (See N65-29750 18-05)

Cold weather survival clothing which conserves body heat by trapped air insulation is discussed. The body's heat control system is reviewed, the merits of quality goose down are discussed, various survival clothing designs are described, and packing recommendations for the clothing are given. R.N.A.

N65-29769 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HUMAN RESTRAINT SYSTEMS DEVELOPMENT FOR USE IN ACCELERATION RESEARCH
Hubert C. Vykukal *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 225–243 refs (See N65-29750 18-05)

Various pilot restraint systems were tested and evaluated under simulated high acceleration conditions. The restraint systems are described and include the modified NASA couch, the universal pilot restraint suit, the soft torso restraint, and the restraint harness-pressure suit system. Using the modified NASA couch, pilots were able to perform control functions without undue discomfort, but, the couch cannot be molded to the body shape while it is in a high acceleration environment and it lacks universal fit. The universal pilot restraint suit eliminates these problems and pilot performed well while subjected to EBI, EBO, and EBD accelerations. However, it has poor provision for lateral restraint at high EBL and EBR accelerations. The soft torso restraint provides more positive support for EBO, EBL, and EBR than the universal pilot restraint suit, but the lack of rigid support from the axilla to the waist allows the rib cage to flatten under EBI acceleration causing difficulty in breathing. R.N.A.

N65-29770 Rocketdyne, Canoga Park, Calif.
SYSTEM SAFETY AS A TECHNICAL DISCIPLINE
George A. Peters and Frank S. Hall *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 244–260 refs (See N65-29750 18-05)

Descriptions are given of some representative safety engineering tasks that are being performed by safety specialists; some other areas in which similar effort could yield significant results are also described. Several methods of safety design analysis are discussed, and a new approach to the quantification of system safety is presented. The goals of system safety engineering as a technical discipline are defined and its relationship with related technical disciplines is made explicit. R.N.A.

N65-29782*# AiResearch Mfg. Co., Los Angeles, Calif.
BLOOD PRESSURE MEASURING SYSTEM 54803, PROJECT GEMINI Final Report
J. S. Gould 7 Apr. 1965 155 p
(Contract NAS9-2887)
(NASA-CR-65057; FC-4550) CFSTI: HC $5.00/MF $1.00 CSCL 06K

Efforts on the development of a blood pressure measuring system for Project Mercury are discussed. The electronic blood pressure measuring system differs slightly in principle from the standard clinical instrumentation. The difference in the two instruments is that the stethoscope is replaced by a microphone, the output of which is conditioned by an electronic amplifier and selective filter. The resulting output on a strip chart recorder is a plot of cuff pressure vs time, depicting the selective bleed-down with superimposed pulses from the Korotkoff sound detection channel. The first pulse during bleed-down denotes the systolic pressure, while the last pulse denotes the diastolic pressure. N.E.A.

N65-29792# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
FATIGUE IN AVIATION ACTIVITIES
Stanley R. Mohler Mar. 1965 17 p refs
(AM-65-13)

This report gives a comprehensive survey of work in the field of aviation fatigue. Both current work still in process and earlier work are surveyed. The nature of fatigue itself is discussed, along with all possible factors that contribute to both physical and mental fatigue. Topics covered include flight-time limitations, indicators of excessive fatigue, new developments related to intercontinental flight and Forest Service flights, and the author's detailed comments and recommendations. Author

N65-29966*# Northrop Space Labs., Huntsville, Ala.
APOLLO EXTENSION SYSTEM PAYLOADS. MANNED FLYING SYSTEM (MFS) KINESTHETIC EFFECTS
D. W. Thomas Jun. 1965 30 p refs
(Contract NAS8-20082)
(NASA-CR-61079) CFSTI: HC $2.00/MF $0.50 CSCL 05H

An analysis of the kinesthetic effects of astronaut movements on the center of gravity of the lunar flying vehicle is presented. The moment capability of the attitude control system is 35 lb ft for the pitch axis and 48.3 lb ft for the roll axis. This corresponds to a center of gravity shift of .208 ft for the pitch axis and .278 ft for the roll axis. The reaction jets are sized to control a disturbance torque which is 40% of the control power available. Using this 40% criteria the center of gravity shift that the system can tolerate is 1 inch for the pitch axis and 1.33 inch for the roll axis. The results indicate that a suited astronaut can exceed this limitation through body motions. R.N.A.

N65-30098# School of Aerospace Medicine, Brooks AFB, Tex.
COPING AND DEVELOPMENTAL THEORY: APPLICABILITY TO SELECTIVE STUDY OF NORMAL MEN

Paul M. Fine and Charles L. Jennings Apr. 1965 39 p *Its* Rev. 1–65
(AD-617745)

A result of a preliminary research is presented to show how coping devices may be observed, categorized, rated, and used in selection procedures. A tape recorded clinical interview based on developmental theory obtained information about individual coping techniques. The interview was independently evaluated by three psychiatrists using a rating list of coping devices. This list concretely demonstrated the application of developmental theory. A research proposal was presented to demonstrate how clinically derived developmental theory can also be adapted to statistical research. The proposal uses a battery of psychologic tests to obtain estimates of ego strengths and coping styles, and a questionnaire to obtain information about events during different developmental stages. R.N.A.

N65-30099# Princeton Univ., N. J.
ANALYSIS OF MEMORY FOR CHANGING INFORMATION Final Report, Mar. 19, 1964–Jun. 30, 1965
Sam Glucksberg 1 Jul. 1965 13 p refs
(Contract DA-31-124-ARO(D)-199)
(AROD-5038-2; AD-617525)

Three series of experiments were performed. The first two concerned the interplay of a limited set of variables in sequential memory tasks which involved keeping track of changing information. The third focussed upon the examination of interference effects in very short-term memory (VTM). The first two series of studies compared the effects of selected traditional variables in (a) standard incremental memory tasks, such as paired-associate and serial learning, with the effects of those same variables in (b) sequential keeping-track tasks. The aim of this research was to specify the ways in which the two kinds of tasks differ. The purpose of the third series, concerning interference effects in VTM, was to evaluate the extent to which interference effects can account for decrements in memory performance over very short time intervals (0-1 second). Author

N65-30119# Graflex, Inc., Rochester, N. Y.
FILMSTRIP TECHNIQUES FOR INDIVIDUALIZED INSTRUCTION
William H. Trow and Edgar A. Smith (AMRL) Wright-Patterson AFB, Ohio, AMRL, May 1965 18 p refs
(Contract AF 33(657)-11339)
(AMRL-TR-65-78; AD-617607)

In the preparation of filmed programed instruction, several considerations are involved in the choice between slides and filmstrips. In this report, the considerations of revision, quantity, length, storage, recycling, aspect ratio, change time, random access and continuous repetition are briefly discussed. A comparison of costs of preparing a master of the filmed program and duplicate copies is made. As a guide to the preparation of filmstrips by staff photographers, some of the problems involved are discussed, namely, single-frame cameras, the preparation of flat copy, exposure and splicing. Other film formats with possible application in audio-visual programing are described. Author

N65-30134# George Washington Univ., Washington, D. C. Human Resources Research Office.
FUNCTIONAL AND APPEARANCE FIDELITY OF TRAINING DEVICES FOR FIXED-PROCEDURE TASKS
John A. Cox, Robert O. Wood, Jr., Lynn M. Boren, and H. Walter Thorne Jun. 1965 51 p refs
(Contract DA-44-188-ARO-2)
(TR-65-4; AD-617767)

Twelve training devices of reduced fidelity were prepared. Several five-man groups were trained using each device, and then each man was given a proficiency test. Intelligence of trainees, teaching method, and instructor effects were statistically controlled. No significant differences in proficiency or length of training time were found to be associated with the training device used, regardless of degree of functional or appearance fidelity. As a field test under more realistic Army conditions, with military instructors and soldiers chosen at random, a low fidelity device was used to train one group while another group was instructed with high fidelity equipment. A comparison of proficiency levels and training times showed only change differences between these two groups. Author

N65-30136# Graflex, Inc., Rochester, N. Y.
AN EXAMINATION OF THE FEASIBILITY OF MODULAR DESIGN FOR AUDIOVISUAL AUTOINSTRUCTIONAL EQUIPMENT
William H. Trow and Edgar A. Smith (AMRL) Wright-Patterson AFB, Ohio, AMRL, May 1965 33 p refs
(Contract AF 33(657)-11339)
(AMRL-TR-65-79; AD-617608)

The increasing need for audiovisual autoinstructional equipment in a wide range of applications has created a major problem in development of satisfactory equipment to meet the varying demands. Each specific situation requires a certain combination of optical, mechanical and electronic functions which cannot necessarily be adapted to subsequent usages of the equipment. This results either in the costly acquisition of many similar pieces of equipment or in undesirable restrictions on the instructional techniques that might be used. This study examines existing and potential areas of application for audiovisual autoinstructional equipment and proposes a modular approach in the development of new equipment. Each module would embody a separable major function and would be interchangeable in the system. The proposed basic modules would include: (1) a slide-changer module, (2) a filmstrip module, (3) a family of screen modules, (4) a family of light source modules, (5) an audio record and playback module, (6) three signal pulsing modules, (7) a multiple-choice response module, and (8) a write-in response module. Many of these would allow operational alternatives or modification for specialized applications for maximum versatility. Author

N65-30149# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INCREASING THE RELIABILITY OF OBJECTIVE PERCEPTION OF VOCAL SOUNDS BY INTRODUCING A REPEATED DEMAND
G. I. Tsemel' 18 May 1965 7 p ref Transl. into ENGLISH from Akad. Nauk SSSR. Lab. Sistem Peredachi Informatsii. Probl. Peredachi Informatsii (USSR), no. 15, 1963 p 77–79
(FTD-TT-65-104/1+2; AD-617656)

For raising the reliability of machine perception, an example is used to illustrate the principle of repeated demand of a word, unclearly pronounced, with unusual dispersion of parameters. In a test of 1320 words, in which 12 people participated, results showed that the repeated demand concept led to a substantial rise in reliability of perception. C.T.C.

N65-30156# Bell Aerosystems Co., Buffalo, N. Y.
INTRA-CREW COMMUNICATION OF B-52 AND KC-135 STUDENT AND COMBAT CREWS DURING SELECTED MISSION SEGMENTS

Maurice Siskel, Jr., Francis D. Lane, William E. Powe, and Ralph E. Flexman Wright-Patterson AFB, Ohio. AMRL. May 1965 29 p ref
(Contract AF 33(616)-7681)
(AMRL-TR-65-18; AD-617598)

An experiment was carried out to compare within-crew communications in B-52 and KC-135 aircraft during peacetime training flights as functions of crew experience and selected mission segments. Crew transmission and message rates were obtained from tape recordings of crew communications on the aircraft interphone system during takeoffs and bomb runs in the bomber and takeoffs and air refuelings in the tanker. In each case, samples were obtained from student crew solo missions and from the combat crew training missions. On the basis of earlier work, it was hypothesized that as a result of their lower level of coordination, the less experienced student crews would have a higher rate of communication than the more experienced combat crews. In two of the comparisons, this hypothesis was confirmed while in two others it was not. Because none of the differences were statistically significant, the results were discussed in terms of the trends which were indicated and several unavoidable compromises in experimental control. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-29150# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL MEASUREMENT OF RHT ABSORPTIVITY OF AIR BEHIND THE FRONT OF A SHOCK WAVE
S. A. Losev and N. A. Generalov 23 Apr. 1965 5 p ref Transl. into ENGLISH from Akad. Nauk SSSR, Komis. po Spektroskopii "Fiz. Probl. Spektroskopii", Materialy XIII Soveshch. Leningrad, 2–12 Iyulya 1960 G., v. 1, 1962 p 114–116
(FTD-TT-64-1223/1+2; AD-615285)

Absorptivity of air heated from 2000° to 4000° K in wavelengths near 2200 Å is considered. Absorption experiments were performed in a mixture of 21% O_2 and 79% Ar, the absorption observed in air at wavelengths of 2200 Å is basically determined in the Schumann-Range bands of O_2, and not by nitrogen oxide. It is shown that at temperatures greater than 3000° K, the absorption decreases. The dependence of the absorptivity on the temperature is also shown. All measurements were done with the aid of an optical system. C.T.C.

N65-29178# Bureau of Mines, Tuscaloosa, Ala. Tuscaloosa Metallurgy Research Center.
ELECTRO-DEWATERING TESTS OF FLORIDA PHOSPHATE ROCK SLIME
Martin H. Stanczyk and I. L. Feld 1964 23 p refs
(BM-RI-6451)

Dewatering of typical Florida phosphate rock slime by electro-osmotic techniques was investigated to determine if a compacted, plastic solid product could be obtained with simultaneous recovery of the water for re-use. Tests with porous cathodes and rod-type anodes imbedded in dilute slime charges of up to 4 tons in weight showed that the slime could be dewatered to about 35 percent solids. The dewatered products had the consistency of modeling clay. In the large-scale tests using 2.5-foot electrode spacings, about 21 kilowatt-hours of power were consumed per ton of water removed in thickening the slime from 17 to 25 percent solids, but the rate of water removal was so slow that the process was not considered commercially feasible. Other tests made with electrode spacings of from 2.5 to 8 feet showed that more rapid dewatering could be obtained but that the power required was excessive. However, for special uses such as stabilizing slime pond dikes where the cost of dewatering might not be a prime requisite, high voltages could be used to rapidly remove the water. Tests of 400-pound slime charges using a combination of electro-osmosis and vacuum filtration showed that the rate of dewatering could be expedited. Author

N65-29181# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
AN ELECTRIC DISCHARGE AS A TRAP FOR DIFFUSION PUMP VACUUM SYSTEMS
R. O. Adams [1965] 14 p refs
(Contract AT(29-1)-1106)
(RFP-572) CFSTI: $1.00

Use of an electrical discharge for trapping silicone fluid vapor is shown to be effective only in a limited sense. The pump fluid vapor is apparently trapped by cracking of the fluid. This effectively eliminates the heavy silicone molecules but in the process several lighter gases are evolved. There is a large increase in the partial pressure of hydrogen in the system when the discharge is operating. With a baffle between the diffusion pump and the discharge a slight improvement in operation is observed. However, an increase in the hydrogen partial pressure is still appreciable. Author

N65-29185# United Kingdom Atomic Energy Authority, Risley (England).
MEASUREMENT OF HELIUM ISOTOPE RATIOS BY MASS-SPECTROMETRIC COMPARISON WITH SYNTHETIC BLENDS WITH A POSSIBLE APPLICATION TO THE LEAK TESTING OF LARGER RIGS
J. R. Fothergill and A. N. Hamer 22 Mar. 1965 15 p ref
(TRG-740 (R)) HMSO: 2s 6d

The relative abundance of helium isotopes in a mixture has been measured by comparison with synthetic blends of known compositions using a modified AEI Type MS3 mass spectrometer. A single collection procedure with direct readout on a carefully calibrated desk meter gave a precision of 1.7×10^{-3} for a single comparison lasting 10 minutes. By intercalibrating a series of synthetic blends, the accuracy of the method was shown to be 2.5×10^{-3} (2σ). The procedure has been applied to measure the relative abundance of small amounts of helium isotopes present in a large excess of carrier gas, during an evaluation of a new method of leak testing large sodium rigs based on an isotopic tracer technique. In this case, a preliminary separation of the helium from the carrier gas is required. The equipment used to do this introduced a small fractionation during sample transfer amounting to 1 ±1%. Author

N65-29198# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Quarterly Technical Report, 9 Apr.–9 Jul. 1965
Joyce J. Kaufman [1965] 12 p
(Contract DA-31-124-ARO(D)-203; ARPA Order 542)
(QTR-5; AD-466669)

Progress is reported on a project to investigate the theoretical and quantum chemistry of energetic N, O, F compounds with the aim of providing an understanding of the fundamental binding and behavior of these species. A discussion is presented on

the semi-empirical LCAO–MO theory, and rigorous LCAO–MO–SCF calculations. N.E.A.

N65-29208# United Kingdom Atomic Energy Authority, Harwell (England). Engineering Div.
INVESTIGATIONS INTO THE USE OF ION EXCHANGE RESINS FOR THE DECONTAMINATION OF RADIOACTIVE EFFLUENT. PART 2: PILOT PLANT TRIALS
J. H. Clarke, W. C. J. White, R. F. Cumberland, and T. D. Wright Apr. 1965 31 p refs
(AERE-R-4905) HMSO: 5s

An ion exchange process for the treatment of radioactive effluent arising at Harwell, has been studied using a 500 g.p.h. pilot plant. Average decontamination factors of 1,000 for α, and 1,250 for β activities were maintained during the treatment of 226,750 gallons. By using a modified regeneration scheme, as devised from laboratory work, the waste arisings from the plant plus those from a pre-filtration stage, were only 2.08% of the throughput. Author

N65-29216# United Kingdom Atomic Energy Authority, Windscale (England). Production Group.
ANALYTICAL METHOD FOR THE DETERMINATION OF (A) TRITIATED WATER AND (B) TRITIUM AND TRITIATED HYDROCARBONS IN REACTOR COOLANT GAS
1965 18 p
(PG-469(W), Rev. 1)

Tritiated water is washed from the gas, purified and the β-activity measured. The carbon dioxide in the dried gas is absorbed in potassium hydroxide and the hydrogen and hydrocarbons in the residual gas oxidized. The water produced is purified and its β-activity measured. Author

N65-29217# United Kingdom Atomic Energy Authority, Springfields (England). Production Group.
ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF THE TOTAL NITROGEN IN ENRICHED URANIUM POWDER
1965 12 p
(PG-585(S))

In the absorptiometric determination of total nitrogen in enriched uranium powder, nitrogen, present as nitrite or nitrate is converted to ammonia separated by distillation and determined absorptiometrically using sodium phenate and sodium hypochlorate reagent. A description is given of the apparatus and method used in the determination of the nitrogen. With the given method, nitrogen determination in the range of 10 to 500 p.p.m. can be made. The range may be extended up to 2000 p.p.m. by taking a smaller aliquot of the sample solution. N.E.A.

N65-29218# Martin Co., Baltimore, Md. Nuclear Div.
DIRECT PRECIPITATION SYNTHESIS OF STRONTIUM TITANATE
J. H. Gray, III and G. Samos Aug. 1964 32 p refs
(Contract AT(30-1)-3062)
(MND-3062-8) CFSTI: $2.00

A simple, efficient and safe procedure for preparation of high density, unlaminated strontium titanate pellets has been accomplished using strontium titanate precipitated from an alkaline mixture of triethanolamine titanium ester (TYZOR TE) and strontium hydroxide. Of the two organic titanates tested, tetraisopropylorthotitanate and TYZOR TE, only the latter presents no fire hazard and can, therefore, be used in the hot cell. Precipitation and washing of the slurry is followed by drying and sintering the strontium titanate powder in a porous filter cup, thereby directly forming the pellet. Thus, the problem of handling dry powder and crushing sintered strontium titanate in the hot cell can be circumvented. The presence of the feed solution contaminants, 1 wt % calcium and 0.5 wt % iron, does not interfere or change any of the precipitation characteristics or properties of the directly precipitated strontium titanate. Author

N65-29236# Bureau of Mines, Boulder City, Nev.
CHLORINATION OF TITANIFEROUS SLAGS: A STUDY OF THE MOVING BED TECHNIQUE
E. C. Perkins, H. Dolezal, H. Leitch, and R. S. Lang 1962 21 p refs
(BM-RI-5983)

As part of a program for developing methods of using domestic titanium deposits, the Bureau of Mines investigated methods for chlorinating titanium slags prepared from titaniferous minerals by electrosmelting. Titaniferous slags were made from ilmenites; titaniferous magnetite was also evaluated. The tests were made in two chlorinators, a 4-inch and a 36-inch unit. Preliminary testing was done in a 40-millimeter bench-type unit. Chlorine gas was contacted with a loose mixture of titaniferous slag and carbon at a high temperature to form titanium tetrachloride. The moving-bed system used involved a downward movement of feed countercurrent to the chlorine flow, and residues continuously removed from the bottom of the reactor. The performance characteristics of these slags depended on their composition, which varied widely according to the geographic source of the ore. The results showed that all but two of the slags could be chlorinated as effectively as rutile, converting 70 to 80 percent of the titanium to the tetrachloride. The two slags contained enough magnesium to cause clinkering, which necessitated that the bed be prematurely withdrawn before more than 70 percent of it could react. The iron content of the slags did not interfere with operating the chlorinators. The data from the 4-inch and the 36-inch units were in agreement on the relative amenability of the slags to chlorination. Author

N65-29254# Tracor, Inc., Austin, Tex.
ELECTROCHEMICAL STUDIES IN THE SYNTHESIS OF N-F COMPOUNDS Quarterly Status Report No. 9, 1 Jan.–31 Mar. 1965
Larry G. Spears, Larry D. Fiel, Wallace E. Harrell, Jr., and Margaret H. Northrup 30 Jun. 1965 28 p refs
(Contract Nonr-4054(00); ARPA Order 399)
(TRACOR-65-224-U; AD-466383)

Work during the past quarter was devoted to the development of analytical methods for quantitative determination of N-F compounds and F_2, and to the investigation of possible new electrode materials. Weight loss measurements, at open circuit and at constant anodic potential were performed on Incoloy 800, Inconel 600, and Ni-Span-C 902. Weight loss rates generally increased with increasing iron content and decreasing nickel content on these alloys. Weight loss measurements and polarization studies were performed on nickel in HF at various water concentrations. The addition of at least 10^{-2}% H_2O reduced corrosion rates of nickel at 6.0 volts. The polarization curves showed a peak dependent on the water concentration on the initial run and a water-dependent plateau in the successive curves. Author

N65-29264# Martin Co., Baltimore, Md. RIAS Div.
THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Quarterly Technical Report, 9 Apr.–9 Jul. 1965
Joyce J. Kaufman [1965] 12 p refs
(Contract DA-31-124-ARO-(D)-203; ARPA Order 542)
(QTR-5; AD-466669)

The theoretical and quantum chemistry of energetic N, O, and F compounds are being investigated to determine their fundamental bonding and behavior. The extended Huckel molecular orbital (XHMO) program is being extended to include a general overlap routine and to introduce d-orbitals into the projection routine. In interpreting the XHMO method as a semi-empirical approximation to the Hartree-Fock theory, two methods of parametrization are being investigated. The XHMO theory is being investigated for its applicability in generating approximate Hartree-Fock reaction surfaces. The $H + H_2$ system is being used. Tentative XHMO calculations on HeF_2 indicate that the system is unstable. Improvements to the polyatom system include the addition of flexibility to the freezing procedures and the program revision to permit the required integrals to be stored on two tapes when there are so many that they overflow a single tape. Research began on methods of integral evaluation routines for Slater orbitals to substitute in place of Gaussian orbitals in the polyatom system. R.N.A.

N65-29269# Michigan Univ., Ann Arbor. Dept. of Chemical and Metallurgical Engineering.
THE KINETICS OF THE TRANSFORMATION OF QUARTZ TO TRIDYMITE IN THE PRESENCE OF OTHER OXIDES
Gerald I. Madden (Ph.D. Thesis) Jun. 1965 70 p refs
(Contract Nonr-1224(47))
(Rept.-05612-2-T; AD-466034)

This investigation is concerned with the kinetics of the transformation of quartz to tridymite, two of the polymorphs of silica (SiO_2). The transformation was studied by heating quartz in the presence of other oxides in the temperature and composition range of tridymite stability. The systems studied were: Na_2O–SiO_2, PbO–SiO_2, FeO–SiO_2, Cu_2O–SiO_2. The temperatures and compositions chosen for study were all in the tridymite plus liquid area of the equilibrium diagrams. In the transformation process under consideration, the formation of cristobalite as an intermediate metastable phase in the tridymite stability range was reconfirmed. The most probable mechanism of transformation is by the solution of quartz into the liquid phase from which cristobalite is precipitated at a relatively rapid rate as a metastable phase. The more stable tridymite precipitates concurrently, but at a slower rate, eventually replacing both the quartz and the cristobalite. Author

N65-29275# Atomics International, Canoga Park, Calif.
THE CHEMICAL REACTIVITY OF URANIUM CARBIDE
E. W. Murbach 30 Jun. 1965 21 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11235)

The chemical reactivity of uranium carbide is a function of its previous treatment. Freshly arc-melted uranium carbide is relatively unreactive toward oxygen, nitrogen, and CO_2. After exposure to laboratory air for a few days, the material becomes reactive. This exposure is accompanied by an increase in apparent surface area of the order of 100 cm^2 per gram. It is postulated that the increase in surface is caused by hydrolysis along grain boundaries and this increase in surface causes the enhanced reaction rates. Author

N65-29276# Los Alamos Scientific Lab., N. Mex.
THE SOLUBILITY OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. IV: EVALUATION OF SAMPLING TECHNIQUES
D. F. Bowersox and J. A. Leary 25 Jun. 1965 6 p refs
(Contract W-7405-ENG-36)
(LA-3303) CFSTI: $1.00

Quench cast, filtered, and unfiltered their samples were taken from liquid Pu saturated with W over the temperature range 700° to 925° C., and the results were evaluated. The three methods were in agreement when saturation was approached from a lower temperature. Only the filtered samples were reliable when saturation was approached from a higher temperature. Author

N65-29291# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE DETERMINATION OF CERTAIN ARTIFICIAL AND NATURAL RADIOACTIVITIES IN RAIN WATER
C. G. Wallace Jan. 1965 44 p refs
(AERE-AM-100) HMSO: 6s

Procedures are described for the determination in rain water of strontium-89 and 90, caesium-137, cerium-141 and 144, barium-140, and of the naturally occurring radionuclides lead-210 (RaD), polonium-210 (RaF) and beryllium-7. Author

N65-29345 Joint Publications Research Service, Washington, D. C.
SEPARATION OF NIOBIUM AND TANTALUM BY CHROMATOGRAPHY OF OPPOSITE PHASES
Chih-Te Hu and Cheng-Li Liu *In its* Transl. on Communist China's Sci. and Technol., No. 196 12 Jul. 1965 p 19–20 refs (See N65-29342 18-34) CFSTI: $3.00

This paper reports a method, using tributyl phosphate (TBP) as the fixed phase, to chromatographically study the possibility of separating niobium and tantalum. Experimental results indicate: excellent separation of niobium and tantalum is possible, when TBP and 20% tannin are used as a stationary phase, with proper ratios of NH_4SCN, $H_2C_2O_4$ and HCl as moving phase. N.E.A.

N65-29346 Joint Publications Research Service, Washington, D. C.
ION EXCHANGE PROPERTIES OF STANNIC PHOSPHATE
Po-Hai Yin and Yung-Hsiang Chu *In its* Transl. on Communist China's Sci. and Technol., No. 196 12 Jul. 1965 p 21–24 refs (See N65-29342 18-34) CFSTI: $3.00

By stabilizing stannic phosphate on New China filter paper made into ion exchange papers and using hydrochloric acid of different concentrations as the unfolding agent, the chromatographic properties of several metallic ions are studied. First, preparation of the stannic phosphate ion exchange paper is described. The influence on the R_f values by different concentrations of HCl is discussed. Groups of mixtures were separated by using separately 0.1N HCl; 0.2n HCl–0.2N KCl (1:1); 0.5N HCl and 3N HCl as unfolding agents to test the separation possibility of the method. The results are presented. N.E.A.

N65-29347 Joint Publications Research Service, Washington, D. C.
CADMIUM–PYRIDINE COMPLEXES
Liang-Nien Chi, Ti-Shen Ts'Ao, Chin-Lien Lo, and Kuo-Ch'in Huang *In its* Transl. on Communist China's Sci. and Technol., No. 196 12 Jul. 1965 p 25–32 refs (See N65-29342 18-34) CFSTI: $3.00

The stability of cadmium–pyridine complexes in water solutions has been widely studied. Large differences have been observed in the results of these studies. It is believed that there exist three deficiencies: first, the concentrations used by several experimenters were not large enough; secondly, some used KNO_3 as the indifferent electrolyte, which is not as good as $NaClO_4$; thirdly, experimental techniques and results were not ideally and correctly disposed. Because of these conditions, the polarographic method is used to study this system again. The conclusions and results of this study are presented. N.E.A.

N65-29405*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

AN APPROXIMATE VARIATIONAL CALCULATION OF PROPERTIES OF THE 1sσ AND 2pσ STATES OF H_2^+

Sungwoon Kim, Tai Yup Chang, and J. O. Hirschfelder 24 Mar. 1964 37 p refs

(Grant NsG-275)

(NASA-CR-58734; WIS-TCI-40) CFSTI: HC $2.00/MF $0.50 CSCL 07D

Calculations were made for the energy of the hydrogen molecule ion at 54 internuclear separations ranging from 0 to 20 a_0 using the Guillemin and Zener approximate wave function for the 1sσ ground state, and its antisymmetric form for the 2pσ first excited state. For the 1sσ state, the Guillemin and Zener energy agreed with the exact energy to within 0.0005 (e^2/a_0) for the full range of internuclear separations; however, for the 2pσ state, at zero internuclear separation, it approached −0.4 (e^2/a_0) instead of the correct value of −0.5 (e^2/a_0). The energy was also calculated by varying only one parameter and fixing the value of the other. Using this method, results for the 1sσ state were found to agree with the exact energy to within 0.001 (e^2/a_0) for the full range of internuclear separations, and to within 0.001 (e^2/a_0) for the first excited state at internuclear separations larger than 4 a_0. This method gave less accurate results at smaller internuclear separations for the 2pσ state and failed to be applicable when the separation was less than 1 a_0. Guillemin and Zener approximations were also inaccurate at small internuclear separations; however, were accurate to within 0.0001 (e^2/a_0) for internuclear separations larger than 4 a_0. S.C.W.

N65-29420*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

POLARIZATION DEPENDENCE OF THE FAR ULTRAVIOLET OPTICAL TRANSITIONS IN CdS

W. C. Walker [1964] 6 p refs Submitted for Publication

(NASA-TM-X-51965) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Various theories on the relationship of direct transitions to valence bonds are reviewed. The room temperature reflection spectrum of a cleaved single crystal of CdS was measured in the region 6 to 11 eV with radiation polarized perpendicular and parallel to the C-axis, in an effort to clarify these data. Employed was a newly developed polarizer constructed from LiF plates which gave polarization of 80% near 1216A (10 eV) and 70% near 1690A (8 eV). Two crystalline effects were observed. These were a strong enhancement of the 7- and 9.2-eV peaks for E⊥C. Results showed that the selection rule for the transition at the 7 eV peak and a corresponding peak at 6.3 eV is E⊥C, in contrast to previously reported data. Efforts to arrive at an assignment of peaks below 10 eV were unsuccessful. The lack of polarization effects in the 8.0 eV peak and the complex nature of the 9 eV peak indicated that the situation in CdS was more complex than in zinc blende materials. S.C.W.

N65-29435*# Stanford Univ., Calif. Instrumentation Research Lab.

FLUORESCEIN AND NAPHTHOL SUBSTRATES FOR PHOSPHATASE ASSAYS

John Westley 1 Jul. 1964 41 p refs

(Grant NsG-81-60)

(NASA-CR-59380; IRL-1010) CFSTI: HC $2.00/MF $0.50 CSCL 07C

The chemistry of fluorescein, fluorescein derivatives, and naphthol derivatives was investigated. Because of its high quantum yield of fluorescence, fluorescein and related compounds provide a suitable starting point for the study of the problem of soil fluorescence which was observed in previous determinations of phosphatase activity in soils using fluorometric assays. The high quantum yield of fluorescein means that 10^{-10} to 10^{-11} molar solutions can be detected using commercially available fluorometers. *B. subtilis* was used to determine the bacterial hydrolysis of 6,6'-dihydroxynaphthofluorandiphosphate. Also, a comparison of the diphosphate and para-nitrophenylphosphate as substrates for phosphatase is included. E.E.B.

N65-29451*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.

ORGANIC NITROGEN COMPOUNDS IN THE ORGUEIL METEORITE

Ryoichi Hayatsu [1963] 11 p refs Submitted for Publication

(Grant NsG-366)

(NASA-CR-58418) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Purines, amino s-triazines, and substituted guanidines were isolated from the Orgueil meteorite and identified by chromatographic, spectroscopic, and other techniques. Of particular interest was the presence of large amounts of s-triazine derivatives, since these compounds have no known biochemical significance. R.N.A.

N65-29473*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOME PROPERTIES OF FERROELECTRIC AND FERROMAGNETIC COMPOUNDS $RMnO_3$

P. H. Fang [1964] 4 p refs Submitted for Publication

(NASA-TM-X-51933) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Properties of the ferroelectric and ferromagnetic compounds $RMnO_3$; where R represents Y, Ho, Er, Tm, Yb, Lu, and Sc; are discussed. The properties discussed include ferromagnetism, ferroelectric–ferromagnetic interactions, ferroelectric switching speed, optical properties, crystal characteristics and growth, and dielectric properties. R.N.A.

N65-29571 Mellon Inst., Pittsburgh, Pa.

AN INFRARED STUDY OF THE INTERACTION OF POLYAMIDES WITH IODINE IN IODINE-POTASSIUM IODIDE SOLUTION

Ikuo Matsubara (Toyo Rayon Co., Ltd., Otsu, Japan) and J. H. Magill *In its* [The Dependence of the Viscoelastic Mech. Properties of Polymeric Matrs. on Mol. and Morphological Struct.] [1965] 44 p refs Presented at the 16th Pittsburgh Conf. on Anal. Chem. and Appl. Spectry., March, 1965 (See N65-29570 18-18)

(Grant NSF GP-1628)

The infrared spectra of thirty-one polyamides of different structures have been examined. The spectral changes which occur on iodine sorption in iodine-potassium iodide solutions and the accompanying changes on iodine desorption with sodium thiosulphate solution have been studied. The spectral observations have been analyzed in relation to the changes in the polymer structures. Results show that polyamides of similar structural types, i.e. "even-even", "odd-odd", etc., usually conform to a given pattern of behavior. It is concluded from the spectral evidence that iodine is involved in complex formation with polyamides as the tri-iodide ion. Author

N65-29574 Mellon Inst., Pittsburgh, Pa.

THE PREPARATION AND CHARACTERIZATION OF SOME STAR- AND COMB-TYPE BRANCHED POLYSTYRENES

T. Altares, Jr., D. P. Wyman, V. R. Allen, and K. Meyersen *In its* [The Dependence of the Viscoelastic Mech. Properties of Polymeric Matrs. on Mol. and Morphological Struct.] [1965] 38 p refs Submitted for Publication (See N65-29570 18-18)

Star-type polystyrenes, polymers with *p* branches attached to a common multifunctional center, and comb-type polystyrenes, polymers with an average of *p* branches attached at random to a polymeric backbone, have been prepared by the reactions respectively of polystyryllithium of narrow chain length distribution with appropriate *p*-functional molecules or with "backbone" polystyrene chains of narrow chain length distribution, containing the prerequisite number of benzylic type chloromethyl groups. The synthesis, isolation, and characterization of these types of polymers are illustrated by specific examples. Problems which are inherent to the system, e.g., metal-halogen interchange reactions, different reactivities of the chloromethyl groups, isomerization of the polystyryllithium and other possible reactions and their consequences are discussed. Author

N65-29578# Naval Research Lab., Washington, D. C.
GAS/SOLID INTERACTION AT VARIOUS DEGREES OF SURFACE COVERAGE
Victor R. Deitz 11 May 1965 42 p refs
(NRL-6225; AD-616116) CFSTI: $1.25

Adsorption and desorption studies of gas/solid interfaces have been, in the past, mainly concerned with considerations of mass balance. A strong effort is now being made to define the initial state of the adsorbing surface in terms of solid state structure and composition and to identify the adsorbent–adsorbate complex. The most important experimental parameter in current researches is probably the influence of the pretreatment of the solid before measurements. The properties of some surfaces may change with time as the strain-stress relationships set up in forming the solid adjust slowly toward minimum surface free energy. The pretreatment may include some combination of thermal, electrical, and chemical methods. Author

N65-29592# United Kingdom Atomic Energy Authority, Wantage (England). Research Group.
ANALYSIS OF ZINC AND COPPER ORES BY RADIOISOTOPE X-RAY FLUORESCENCE
J. R. Rhodes, T. G. Ahier, and D. O. Poole Aug. 1964 40 p refs Presented at the Symp. on Anal. Instrumentation, Windscale, England, 4–5 Dec. 1963
(AERE-R-4474) HMSO: 5s 6d

Zinc and copper ores were excited, and the fluorescent X-rays of ZnK and CuK were isolated with the use of differential filters in the form of thin foils placed between the source and the detector window. The radioactive emissions were statistically counted. Two other aspects of X-ray analysis, suppression of interelement effects and presentation of powdered solids, are also described. The accuracy and sensitivity of the cheap, compact, and simple technique were shown to be no worse than those generally obtained by conventional techniques. Measurement of the zinc content of zinc ore slurries is feasible by radioisotope X-ray fluorescence using a 0.5 mc Cd^{109} source for X-ray excitation and differential filters of Cu and Ni for selecting Zn K_α X-rays. The copper content of copper ore in the form of dry powders can also be measured with this source, using differential filters of Fe and Ni and a simultaneous measurement of transmitted X-ray intensity in order to eliminate the severe interelement effect due to iron. L.S.

N65-29624*# Iowa State Univ. of Science and Technology, Ames. Dept. of Chemical Engineering.
INVESTIGATION OF UNIQUE GAS PERMEABILITY CELL SYSTEM TO REMOVE CO_2 AND OTHER NOXIOUS GASES FROM SPACECRAFT CABINS Final Report, Period Ending Mar. 31, 1965
Coleman J. Major [1965] 110 p refs
(Contract NASr-73)
(NASA-CR-65073) CFSTI: HC $4.00/MF $0.75 CSCL 07D

Gas permeability cell prototypes were constructed using silicone rubber as the semipermeable membrane. The polymer has a carbon dioxide to oxygen separation factor of approximately 5 at room temperature. Pure gas permeability measurements revealed that the carbon dioxide permeability rate is constant over the temperature range of 0° to 50° C while the oxygen rate is directly proportional to temperature. This indicates that better separation factors are possible at the lower temperatures. The cell prototypes were tested on their ability to separate dilute mixtures of carbon dioxide in oxygen. Constant temperature runs of 40°, 25°, and 0° C were made using feed compositions ranging from 1% to 10% CO_2. The cells were found to be somewhat pressure sensitive and ruptured under pressures greater than 5 psia on the high pressure side of the membrane. It was observed that a cascade system is required for permeability separations wherein a nearly complete separation is required. This was attributed to the small magnitude of the separation ratio. Good correlation was found between theoretical and actual data. R.N.A.

N65-29647*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
VACUUM COMPATIBILITY OF ENGINEERING MATERIALS (SOLIDS) II
J. G. Austin and J. B. Gayle 24 Jun. 1965 166 p refs
(NASA-TM-X-53286) CFSTI: HC $5.00/MF $1.00 CSCL 07D

The rate and extent of weight loss of 62 solid materials in a vacuum environment were determined experimentally by continuous and intermittent weighing techniques. Test conditions ranged from 41° C to 200° C at pressures of 10^{-2} to 10^{-5} torr. The results are presented in 2 tables and 130 figures. Author

N65-29662# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
SUMMARY OF AVAILABLE INFORMATION ON PLUTONIUM NITRATE SOLUTION INSTABILITY
F. J. Miner 23 Jan. 1964 18 p refs
(Contract AT(29-1)-1106)
(RFP-357)

Shipper–Receiver Difference—The shipper–receiver differences experienced during two periods of time when production batches of feed nitrate were sent from Hanford to Rocky Flats are summarized. A comparable summary has also been made for shipments from Oak Ridge to Rocky Flats. The Analytical Laboratory Sample Exchange Program for plutonium nitrate solutions as well as metallic plutonium samples exchanged at the same time is also summarized. Plutonium Nitrate Solution Instability—A literature review has been made of the formation and precipitation of plutonium (IV) polymer. Suggestions for avoiding polymer are given. The possibility of the formation of insoluble compounds of plutonium (IV) with inorganic anions or organic compounds resulting from the degradation of anion exchange resins is also discussed. Author

N65-29693# State Univ. of Iowa, Iowa City. Dept. of Chemistry.
HIGH TEMPERATURE POLYMERS FROM 1,3 DIPOLAR ADDITION REACTIONS Quarterly Progress Report, 1 Feb.–30 Apr. 1965
John K. Stille 30 Apr. 1965 24 p refs
(Contract DA-11-070-AMC-832(W))
(QPR-1; AD-462323)

The scope of 1,3-dipolar addition reactions which may be employed as propagation reactions in polymerization, and a survey of what is known about these reactions is presented. The synthesis of *p*-phenylene-3,3′-disydnone and the model reaction of this double 1,3-dipolarophile with phenyl acetylene has been carried out. The synthesis of a bis-nitrile-imine precursor, and two double dipolarophiles has been accomplished. Author

N65-29700# Naval Research Lab., Washington, D. C.
γ-Fe_2O_3 AND THE PASSIVITY OF IRON
M. C. Bloom and L. Goldenberg 18 Jun. 1965 10 p refs
(NRL-6259; AD-466482)

In the past few years a large amount of evidence has been obtained which indicates that passivity in the system Fe–O–H_2O at room temperature is associated with the presence of a thin protective film having a modified form of the spinel structure of magnetite (Fe_3O_4). It seems to have been fairly well established that this protective film comprises two layers. The lower layer is a conductive film, usually specified as Fe_3O_4, in direct contact with the unoxidized metal; this layer is covered in turn by an electrically insulating film of what has been called γ-Fe_2O_3. This γ-Fe_2O_3 had been visualized as a spinel structure containing vacancies. It is concluded that such protective films cannot be merely spinel structures containing vacancies but are modifications of the Fe_3O_4 structure in which protons are substituted for some of the ferrous ion and that "γ-Fe_2O_3" is the end result of such a substitution when all ferrous ion has disappeared. Author

N65-29714# Liège Univ. (Belgium).
PHYSICO-CHEMICAL RESEARCH ON THE TRANSPLUTONIUM ELEMENTS
F. Caligara, Ph. Dreze, G. Duyckaerts, J. Fuger, J. Goffart et al Brussels, EURATOM, 1965 61 p refs
(Contract EURATOM-003-61-2 TPUB)
(EUR-2297.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 85 Belg. Fr.

Various elements were studied experimentally to gain a better understanding of the relationship between chemical properties and electronic structure. The research consists of thermodynamic study of the complexes formed by transplutonium elements and (where possible) lathanides and actinides with complexing agents of the organic phosphorus and long-chain amine types; the liquid–liquid extraction method was used. Also, a device for physico-chemical study of plutonium and transplutonium elements in molten alkali chloride bath was developed. J.M.D.

N65-29727*# National Aeronautics and Space Administration, Washington, D. C.
STUDY OF A METHOD OF LOCAL CHEMICAL AND ISOTOPIC ANALYSIS USING SECONDARY ION EMISSION
G. Slodzian Jul. 1965 166 p refs Transl. into ENGLISH of the thesis "Etude d'une Metode d'Analyse Locale Chimique et Isotopique Utilisant l'Emission Ionique Secondaire" Univ. of Paris, 1964
(NASA-TT-F-9460) CFSTI: HC $5.00/MF $1.00 CSCL 07E

A semi-quantitative microanalysis method with secondary ion emission, for directly obtaining distribution electron images whose limit of resolution is of the order of microns, permitting localization of a given light element in a chemical bond and isotopic analysis, is described. The obtainable results are demonstrated on the example of identification of oxides and are extrapolated to all possible solids including metals and minerals. The physical principles of conversion of ion to electron images are discussed, and formulas for computing second- and third-order aberrations are derived. The experimental apparatus, working with argon ion gun, immersion lens, and fluorescent screen, is described in detail, with suggestions for further improvement in resolving power and sensitivity. Author

N65-29728*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF CARBONACEOUS METEORITE MATTER BY THE MICRODIFFRACTION OF SUPER HIGH-SPEED ELECTRONS [ISSLEDOVANIYE UGLERODISTOGO VESHCHESTVA METEORITOV METODOM MIKRODIFRAKTSII SVERKHBYSTRYKH ELEKTRONOV]
A. P. Vinogradov, G. P. Vdovykin, and N. M. Popov Jul. 1965 11 p refs Transl. into ENGLISH from Geokhimiya (Moscow), no. 4, 1965 p 387–390
(NASA-TT-F-0461) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The structure of high-molecular carbonaceous matter of stony meteorites (carbonaceous chondrites) Mighei, Cold Bokkeveld, Staroye Boriskino, of the Novyy Urei ureilite and the Burgavli iron meteorite has been investigated. The investigation was carried out with the aid of super-voltage electron microscope electronography (accelerating voltage 400 kV), which ensures the allowable thickness of the object of about 1μ. In carbonaceous chondrites the carbonaceous matter is represented by high-molecular organic compounds of an amorphous and crystalline structure with very fine black carbon. Besides organic polymers, graphite and diamond, the chief constituting phases of the carbonaceous matter of this meteorite type, are present in ureilite. In the Burgavli meteorite the chief phase is carbon-graphite; black carbon and high-molecular organic compounds are also present. The structure of the carbonaceous meteorite matter allows judging the character of evolution not only of the carbonaceous matter but also of the meteorites themselves. Author

N65-29733*# National Aeronautics and Space Administration, Washington, D. C.
PREPARATIVE METHODS FOR ALLOYS USING SULFUR [O METODAKH SINTEZA SPLAVOV I SOYEDINENIY S UCHASTIYEM SERY]
P. G. Rustamov and B. N. Mardakhayev Jul. 1965 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Azerb. SSR (Baku), v. 20, no. 9, 1964 p 13–15
(NASA-TT-F-9487) CFSTI: HC $1.00/MF $0.50 CSCL 07B

An alternative to the conventional methods for preparing alloys and solid is offered for highly volatile components. As usual, the materials are placed in an evacuated ampule, but the furnace is at first inclined in a semihorizontal position, creating a temperature gradient that is controllable by raising or lowering the ampule in the furnace. Subsequently, the entire arrangement is righted, and the process continues according to the conventional vertical method, except that at first a difference in temperature is maintained, eventually going over to a uniform temperature. The outcome is the synthesis of more alloy in a given time with safety. The authors were able to prepare 18 to 20 g of gallium sulfides (GaS and Ga_2S_3) in two to four hours using the method described. Author

N65-29735*# National Aeronautics and Space Administration, Washington, D. C.
DIFFUSION OF SULFUR IN IRON [K VOPROSU O DIFFUZII SERY V ZHELEZE]
I. F. Kononyuk Jul. 1965 7 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 19, 1965 p 311–313
(NASA-TT-F-9491) CFSTI: HC $1.00/MF $0.50 CSCL 07B

In order to resolve the conflict in values given in the literature for the diffusion coefficient of sulfur in α- and γ-iron, experiments have been conducted with a heavy sulfide layer (constant diffusion source) and high-grade iron. The diffusion

coefficients are calculated by the standard plot method. The results indicate distribution of the sulfur along the grain boundaries as point inclusions, with boundary diffusion proceeding via intergranular strate of the iron. Practically the same diffusion coefficient (1.6 and $1.3 \cdot 10^{-9}$ cm^2/sec, respectively) is obtained in γ-iron and α-iron single crystals, the latter having a lesser imperfection of the crystal structure and fewer dislocations in the less disordered intergranular strata. Author

N65-29737*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE RADIOLYSIS OF AMMONIA ADSORBED ON SOLID SURFACES BY THE ELECTRON PARAMAGNETIC RESONANCE METHOD [ISSLEDOVANIYE RADIOLIZA AMMIAKA ADSORBIROVANNOGO NA TVERDYKH POVERKHNOSTYAKH METODOM e.p.r.]
Yu. A. Sorokin, A. G. Kotov, and S. Ya. Pshezhetskiy Jul. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 159, no. 6, 1964 p 1385–1388
(NASA-TT-F-9498) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The effects of gamma-irradiation of ammonia adsorbed on a zeolite surface are investigated in order to gain information as to the phenomena occurring in the sorbent and sorbate as a part of radiocatalytic reaction. The effects are analyzed by measurement of the EPR spectra. The behavior of NH_2 radicals in various matrices and solutions is discussed, indicating a decrease in concentration of such radicals as the surface coverage of the zeolite is increased above a monolayer. Increased ammonia adsorption also appears to promote recombination of the radicals through local heating, the percentage recombination increasing with ammonia charging of the surface. Author

N65-29780*# California Univ., Berkeley. Space Sciences Lab.
STUDY OF DETONATION OF MIXTURES OF GASEOUS HYDROGEN AND GASEOUS OXYGEN Final Report, Jun. 1, 1962–Feb. 18, 1965
A. J. Laderman Apr. 1965 267 p refs *Its* Ser. 6, Issue 11
(Contract NAS8-2634)
(NASA-CR-64032) CFSTI: HC $6.00/MF $1.50 CSCL 07B

Progress is reported on an investigation to determine the detonability of hydrogen–oxygen mixtures of various compositions, in vessels of size comparable to interstage compartments, under selected environmental conditions. The experimental program was comprised of two distinct phases. The first was devoted primarily to determining steady detonation parameters, and made use of a high energy ignitor consisting essentially of a two inch length of 400 grain Primacord, a commercial detonating fuse. The second phase of the program was concerned with the use of weak ignitors and provided information on the detonability of hydrogen–oxygen mixtures in the absence of externally produced shock waves. N.E.A.

N65-29900# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF THE CATALYTICAL ACTIVITY OF MIXING CATALYSTS. THE COMPOSITION OF THE CATALYTICALLY ACTIVE CENTERS OF Ni-Mg MIXING CATALYSTS
W. B. Lebedew 8 Jun. 1965 20 p refs Transl. into ENGLISH from Z. Physik. Chem. (Frankfurt), v. 225, no. 1, 1964 p 101–115
(FTD-TT-62-221/1+2; AD-466258)

Equations are given to determine the number of n-atomic ensembles on the surface of mixed catalysts, the catalytic activity of the mixing catalyst, and the number of atoms in the active center of the mixing catalyst. Catalytic activity of the mixing catalyst is also expressed in the case of a linear relationship of the surface to the atom percent content. Available experimental results are discussed in terms of the theory, and equations are presented for nickel–magnesium catalysts. Reduction of acetone and hydrogenation of benzine with NiMgO catalysts are presented graphically, and previous conclusions are confirmed by the relative position of the maximum activity. Data are also presented of the active structure in the hydrogenation of (1) the cinnamic acid ester and (2) cyclohexane in a benzine solution with mixed Ni–Mg oxalates. The active centers of the Ni–Mg mixing catalysts are also discussed, and results are presented in tabular form. M.W.R.

N65-29911# Naval Ordnance Lab., White Oak, Md.
INFRARED ANALYSIS OF THE POLYMERIZATION AND LONG-TERM STABILITY OF EPOXY RESINS
Doris V. Steele Aug. 1965 21 p refs
(NOLTR-65-84; AD-466612)

Infrared analysis of epoxy resins utilizes the known fingerprint for these polymers at 2.95, 10.93 and 11.6 microns bands. Five epoxy compounds were studied and the polymerization monitored during 18 months storage time. Three systems reached a stable condition in less than two months, and two systems were still unstable after 18 months storage time. These data correlate extremely well with electrical resistivity data obtained for three of the systems studied. Both electrical resistivity data and infrared analysis provide a sensitive means of determining the long-term stability of epoxy resin systems. Author

N65-29912# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONVERSIONS OF SILICON–CARBON–HETEROCYCLENE UNDER THE INFLUENCE OF ALUMINUMCHLORIDE
V. M. Vdovin, N. S. Nametkin, V. I. Zav'jalov, and K. S. Puscevaja 14 Jul. 1965 12 p Transl. into ENGLISH from J. Prakt. Chem. (Germany), v. 23, no. 5, 1964 p 281–287 Presented at 2nd Dresden Symp. on Org. and Non-silicated Silicon Chem., 26–30 Mar. 1963
(FTD-TT-65-353/1+4)

With 1,1-Dimethylsilacyclopentane a ring-chain polymerization to oily or rubber-like production can be carried out with $AlCl_3$. If chlorine, phenyl, or benzyl groups or residues are present as substituted with attached groups that function as carbon, then polymerization does not occur. Bis (methyltetramethylenesilane) ethylene is polymerized to an insoluble trimmer. From 1-(gamma-chloropropyl)-1-methylsilacyclopentane the corresponding chlorsilane was produced with $AlCl_3$ by separating cyclopropane. A six-membered ring is formed by the influence of $AlCl_3$ on 1-chloromethyl-1-methylsilacyclopentane. The polymer of 1-hydro-1-methylsilacyclopentane can be oxidized with atmospheric oxygen and cross-linked. It is possible to add gamma-cyanopropyl residues to the HSi groups. The reactions were followed by means of IR-spectra and the reaction mechanism was discussed. Author

N65-29914# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
CORROSION OF MATERIALS BY ETHYLENE GLYCOL-WATER
J. D. Jackson, P. D. Miller, F. W. Fink, and W. K. Boyd 10 May 1965 25 p refs
(Contract AF 33(615)-1121)
(DMIC-216; AD-466284)

Solutions of ethylene glycol are being considered as heat-transfer media for radiators in manned space capsules. This report was prepared to summarize the available corrosion data on uninhibited and inhibited ethylene glycol solutions. Much of the corrosion data are based on automotive and diesel engine coolant systems. Several factors considered

are: time dependence, effect of pH, concentration, temperature, aeration, chloride ion, velocity, heat-transfer rate, and galvanic couples. Inhibitors for which corrosion data are presented include: borax, sodium benzoate, sodium nitrite, triethanolamine, sodium mercaptobenzothiazole, soluble oil, chromates, as well as miscellaneous inhibitors. A number of patented inhibitors based on borax are discussed. Descriptions of test procedures including automobile service tests are presented. Author

N65-29916# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
THE PRODUCTION OF COLORED SMOKES FROM HIGHLY REACTIVE HYDROLYZABLE METAL CHLORIDES
Alfred F. Tatyrek Aug. 1965 39 p refs
(PA-TM-1644; AD-467274)

Several cyclic ethers and substituted phenols reacted to produce highly colored $TiCl_4$ substitution and addition compounds, some of which seemed readily soluble in $TiCl_4$. A number of the compounds reacted rapidly enough to produce colored smoke clouds by instant interaction with the $TiCl_4$. Chromyl chloride (CrO_2Cl_2) and vanadyl chloride ($VOCl_3$) were found to vaporize and hydrolyze with atmospheric moisture to form, respectively, a yellow chromium trioxide smoke and an orange-colored hydrated vanadium pentoxide smoke. A greater smoke density was obtained by mixing these compounds with $TiCl_4$. At relative humidities exceeding 70%, the smoke clouds produced by chromyl chloride and vanadyl chloride rapidly lost their color and turned white. However, increasing the amount of $VOCl_3$ did significantly prolong the color of the smoke cloud. Several reducing agents were found which reacted with titanium tetrachloride, chromyl chloride, and vanadium oxytrichloride to produce violet, blue, and green smoke clouds. Author

N65-29920# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
REVERSIBLE OXYGEN ELECTRODES Twelfth Quarterly Report [Final], 1 Oct.–31 Dec. 1964
M. Genshaw, V. Brusic, and A. Damjanovic [1964] 37 p refs
(Contract DA-36-039-SC-88921)
(Rept.-12; AD-616779)

Achievements during the course of this Project have been briefly summarized. A rotating disk electrode with a concentric ring was shown to be a valuable tool in discriminating between possible mechanisms in O_2 reduction. On platinum electrodes in highly purified acid solutions the reduction is a 4-electron process until the electrode potential below 0.1 V with respect to N.H.E., when H_2O_2 starts forming. At 0.00 V, nearly all current is due to H_2O_2 formation. In not highly purified solutions, the current on the disk shows a maximum which is less than the limiting current, and then with the potentials becoming more cathodic, current decreases. This deactivation is due to the adsorption of the impurities, and the correlation between the shape of the oxygen reduction curve and an adsorption isotherm is apparent. In alkaline solution H_2O_2 is an intermediate. Possible mechanisms for O_2 reduction are discussed for both acid and alkaline media. Author

N65-29954*# National Aeronautics and Space Administration, Washington, D. C.
SYNTHESIS OF PHOSPHONIC POLYESTERS BY TRANSESTERIFICATION
Samuel Kohn Aug. 1965 26 p refs Transl. into ENGLISH from Rech. Aerospatiale (France), no. 103, 1964 p 19–26
(NASA-TT-F-379) CFSTI: HC $1.00/MF $0.50 CSCL 07C

The results of experiments in the preparation of phosphonic polyesters by three methods of transesterification (alcoholysis, acidolysis, and true transesterification) are presented following a survey of the pros and cons of the various syntheses of phosphonic polyesters. Acidolysis is the simplest technique for the preparation of polyphosphonates, but polyphosphonates of a diphenol can be prepared by the alcoholysis of a diphenyl phosphonate. It is also shown that true transesterification never occurs. When it appears to take place, what actually occurs is acidolysis by the free phosphonic acid formed by thermal destruction of the ethyl phosphonate used to initiate the reaction. Author

N65-29990# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DERIVATION OF NEW POLYMERS WITH BENZIMIDAZOLINE LINKS IN BASIC CHAIN
N. A. Adrova, A. M. Dubnova, and M. M. Koton 4 Jun. 1965 7 p refs Transl. into ENGLISH from Vysokomol. Soyedineniya (USSR), v. 6, no. 8, 1964 p 1493–1495
(FTD-TT-65-304/1+2; AD-615991)

Polymers with benzimidazoline units in the principal chain have been synthesized by polycondensation of 3,3',4,4'-tetraaminodiphenyl with aromatic dicarbonyl compounds. The latter comprised aromatic dialdehydes and their acetals and aromatic diacetyl compounds. The polymers were obtained in the form of non-fusible, light brown powders. Author

N65-29992 Naval Ordnance Lab., Corona, Calif.
NONAQUEOUS SOLVENT ELECTROCHEMISTRY
R. E. Panzer *In its* Chemoelec. Energy Conversion for Nonaqueous Reserve Batteries 15 Apr. 1965 p 1–9 refs (See N65-29991 18-03)

Research was conducted on reference electrodes usable in liquid NH_3 solution either at ambient pressure or in cells pressurized to 70 kg per square centimeter. A literature survey was made of possible reference electrode metals and compounds with regard to solubility, reactivity, and conductivity in liquid NH_3. Investigations with $Pb/PbCl_2$, Tl/TlCl, In, and Ga produced interesting results and the problem was defined through use of these materials. Nitrided metals were prepared for use in NH_3. An exhaustive chronopotentiometric survey was conducted of acids soluble in liquid NH_3 to determine the limiting potentials of these materials. From this data it is possible to predict why voltaic cells incorporating some of these acids will not operate satisfactorily. R.N.A.

N65-29993 Naval Ordnance Lab., Corona, Calif.
ELECTROREDUCTION OF ORGANIC CATHODE MATERIALS IN LIQUID AMMONIA SOLUTIONS
W. S. Harris *In its* Chemoelec. Energy Conversion for Nonaqueous Reserve Batteries 15 Apr. 1965 p 9–12 refs (See N65-29991 18-03)

Progress is reported on the electroreduction of organic cathode materials in liquid ammonia solutions. On the basis of new test information, research hardware cell tests were conducted using the positive halogen compound trichloromelamine. Tests were made of a new type of cell construction that eliminated completely what is normally the electrolyte. In view of the simplicity of construction, these cells gave quite promising results. R.N.A.

N65-30020# California Univ., Berkeley. Lawrence Radiation Lab.
THE PRODUCTION OF TRITIUM LABELED METHANE AND ETHANE IN THE CH_4–T_2 SYSTEM
John B. Nash (Ph.D. Thesis) 12 Apr. 1965 60 p refs
(Contract W-7405-ENG-48)
(UCRL-16009)

The rates of tritium incorporation into labeled methane and ethane in the methane-tritium system was investigated. Production of the tritiated products was expressed by a sum of two terms: the decay-induced labeling which is independent of time; and the radiation-induced labeling which is inversely proportional to time. The incorporation rate of tritium into product from the radiation field is shown to be dependent on the absolute molecular concentration of tritium, and on its concentration as a source of radiation. The yields of labeled methane and ethane from the decay labeling is directly proportional to the decay rate of the tritium, and the incorporation rate of tritium into labeled ethane is larger than that for incorporation into tritiated methane. A mechanism for both series consistent with the results is proposed. The effect of additives was also determined. Addition of hydrogen elucidated the rate of labeling from the decay-induced series. Xenon enhanced the product yield by 15% in concentrations up to 30 mole percent. Addition of ethylene in amounts less than 2 mole percent suppressed the labeling rate until the ethylene disappeared by reaction with the radiolytic products. The effect on product formation of varying the pressure and the surface to volume ratio is also discussed. L.S.

N65-30048# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SYNTHESIS OF ANTICORROSION PIGMENT–CHROMIUM PHOSPHATE

M. A. Shtern, N. Ye. Danyushevskaya, and O. V. Alekseyeva 14 May 1965 9 p refs Transl. into ENGLISH from Lakokrasochnyye Materialy i Ikh Primeneniye (Leningrad), no. 1, 1964 p 32–34
(FTD-TT-65-55/1+2; AD-616308)

Optimum conditions for synthesizing chromium phosphate for use as an anticorrosion pigment in phosphatization priming and single packing bases were investigated. The effect of chemical composition of chromium phosphate on its protective qualities was studied and the results tabulated. Tests also showed that the dispersion composition of the pigment exerted practically no effect on the anticorrosion properties of the sealer. The kinetics of the process of chromium reduction with sodium sulfite, and deposition of phosphate were investigated in the pH range from 1.0 to 4.5. It was found that the rate of chromium reduction and precipitation of chromium phosphate is affected by the temperature conditions of the synthesis. The optimum conditions are listed, and the investigations show that chromium phosphate, synthesized under these conditions appears to be a highly effective anticorrosion pigment which can be used for pigmentation of single packing sealers of VL-02 type. M.R.W.

N65-30051# Rocky Flats Div., Dow Chemical Co., Golden, Colo.

[HEALTH PHYSICS, LABORATORY SERVICES, AND NONDESTRUCTIVE TESTING] Technical Services Quarterly Progress Report, Dec. 1964–Feb. 1965

C. W. Piltingsrud et al 24 Jun. 1965 14 p
(Contract AT(29-1)-1106)
(RFP-552) CFSTI: $1.00

Research results in the areas of health, laboratory experiments and analyses, and nondestructive testing are reported. Health physics investigations consisted of the following: (1) measurements of Pu^{239}–Am^{241} in several human subjects; (2) an ion exchange procedure for the isolation of Pu from routine urinalysis samples; (3) development of two counters for use during surgical operations on Pu^{239}-contaminated wounds; and (4) a low-temperature (−20° C) refrigeration unit for use in cooling a photomultiplier tube. The dimethylglyoxime determination of nickel in plutonium, the volumetric determination of plutonium in plutonium fluoride, and solids analysis by spark source mass spectrometry are among the subjects considered in laboratory experiments. Nondestructive testing consisted of closure weld tests, oxygen analysis by neutron activation, and drop tests on shipping containers. C.T.C.

N65-30057# Bureau of Mines, Berkeley, Calif.

HEAT OF FORMATION OF TANTALUM CARBIDE

Alla D. Mah 1965 9 p refs
(BM-RI-6663)

The heat of combustion of $TaC_{0.996}$ was determined by oxygen bomb calorimetry to be −302.8 ±0.4 kcal/mole. The corresponding heat of formation of $TaC_{0.996}$ is −35.4 ±0.5 kcal/mole, and the calculated heat of formation of $TaC_{1.00}$ is −35.5 ±0.5 kcal/mole. Author

N65-30067# Syracuse Univ., N. Y. Coll. of Forestry.

SOME PROPERTIES OF STIFF MACROMOLECULES. I: MOLECULAR DIMENSIONS OF A WORM-LIKE CHAIN. II: HYDRODYNAMIC BEHAVIOR OF CELLULOSE TRINITRATE Final Technical Report, Aug. 15, 1960–Dec. 31, 1963

Ralph Cummings (Ph.D. Thesis) Jun. 1965 207 p
(Grants DA-ORD-26; OA-ARO(D)-31-124-G14; DA-ARO(D)-31-124-G168)
(AROD-2785-1; AD-615909)

Interaction parameters, polydispersity, rod-like models, and partial free-draining models were studied for understanding the hydrodynamic behavior of cellulose trinitrate, a stiff macromolecule. A discussion of Gaussian and worm-like statistics for stiff macromolecules is presented, with tables and graphs of experimental and theoretical mean, mean square, mean reciprocal, and mean reciprocal square end-to-end distances; and the approach is adapted to the study of the cellulose trinitrate macromolecule. Viscosity, sedimentary, osometric, and fractionation data were obtained experimentally, and the data are tabulated and presented in graphic form. L.S.

N65-30112# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

X-RAY ANALYSIS OF THORIUM TUNGSTATE AND THORIUM MOLYBDATE

V. K. Trunov and L. M. Kovba 15 Apr. 1965 6 p ref Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. II: Khim. (Moscow), no. 3, 1963 p 60–63
(FTD-TT-64-1151/1; AD-614955)

An X-ray analysis was made of molybdate and tungstate of thorium. Mixtures of stoichiometric amounts of original oxides were roasted at temperatures of 750 to 1,000C. The X-ray pictures of the specimens, were done on CuK sub a radiation in the Guignet focusing camera with a curved single crystal of Ge as a monochromator. By the method of X-ray-phase analysis, there was established the existence only of $Th(MoO_4)_2$ and $Th(WO_4)_2$. TAB

N65-30133# Columbia Univ., New York.

THE HYDRIDE METHOD FOR THE RAPID DETERMINATION OF 'FREE' WATER IN MINERALS

Necip Güven and Paul F. Kerr Feb. 1965 18 p refs *Its* Sci. Rept. 3
(Contract AF 19(604)-8387)
(AFCRL-65-130; AD-617561)

A rapid procedure for the determination of 'free' water in minerals is described which makes use of the reaction:

$$CaH_2 + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$$

The pressure change caused by H_2 in the reaction is measured and the corresponding moisture content calculated. Parallel

determinations using oven drying have been made in order to show the differences between the two methods. The hydride procedure measures only 'free' water whereas the conventional heating method includes both 'free' water and water of 'activated' adsorption and/or water of hydration involving adsorption energies greater than 5–10 Kcals per mole. Author

N65-30170# Soreq Research Establishment, Israel Atomic Energy Commission, Yavneh.
ACTIVITY COEFFICIENTS OF VARIOUS ELECTROLYTES. MOLAL AND MOLAR CONCENTRATIONS
M. Gazith Oct. 1964 25 p
(IA-1004)

Molal and solar concentrations were calculated by a numerical method for round values up to very high concentrations for 33 electrolytes, acids, bases and salts. The concentration values are tabulated together with molal activity coefficients, at 25° C, fitted graphically for each concentration. Introductory notes and 10 references. Author

N65-30171# California Univ., Berkeley. Lawrence Radiation Lab. Inorganic Materials Research Div.
THE ACTIVATION ENERGY FOR THE SUBLIMATION OF GALLIUM NITRIDE
Zuhair A. Munir (San Jose State Coll., Calif.) and Alan W. Searcy 31 Dec. 1964 14 p refs
(Contract W-7405-ENG-48)
(UCRL-10702, Rev.)

Gallium nitride was found to sublime congruently from a torsion-effusion cell when the ratio of orifice area to sample area was about 1/30 and incongruently to yield nitrogen gas and liquid gallium when this ratio was about 1/100 or less. A mass spectrometer investigation revealed no measurable concentrations of gallium nitride vapor molecules. The heat of activation for the reaction $2GaN(s) = 2Ga(l) + N_2(g)$ was calculated to be 39 kcal at 1300° K from the temperature dependence of the effusion data. The rate of the reaction $2GaN(s) = 2Ga(g) + N_2(g)$ was measured by a torsion-Langmuir method. From the temperature dependence of sublimation the heat of activation for this reaction was calculated to be $\Delta H^{\ddagger}_{1300} = 218.6$ kcal compared to 173 kcal for the equilibrium reaction, and the entropy of activation was calculated to be 74.3 cal/deg. Author

N65-30174# Oak Ridge National Lab., Tenn. Chemistry Div.
THE ABSORPTION ON SPECTRA OF H_2O AND D_2O IN THE NEAR INFRARED REGION AS A FUNCTION OF TEMPERATURE FROM −20° TO 250°C
W. C. Waggener, A. J. Weinberger, and R. W. Stoughton [1965] 12 p refs Abstract of a Paper Presented at Div. of Phys. Chem., Detroit, 4–9 Apr. 1965
(Contract W-7405-ENG-26)
(ORNL-P-925)

We are studying the spectra of water in the condensed states between 0.7 and 2.0μ and have measured the temperature dependences of the broad $(2\nu_1 + \nu_3)$ and $(\nu_1 + \nu_2 + \nu_3)$ absorption bands of H_2O and D_2O in ice to 20° below the freezing point, in the super-cooled liquid to 15° below the freezing point, and in the liquid from the freezing point to 250° C and ca. 39 atm. The spectra of H_2O and D_2O are qualitatively similar; however, the D_2O bands occur at longer wavelengths by a factor of 1.35, are broader, more complex, less intense, and factor of 1.35, are broader, more complex, less intense, and generally less temperature sensitive. Part of these differences may stem from 0.2 mol % H_2O in the D_2O used. The observed frequency shifts of both the $(2\nu_1 + \nu_3)$ and $(\nu_1 + \nu_2 + \nu_3)$ bands in the following condensed phases from the frequencies of these bands in the dilute gas (literature values) are about −1.7% for liquid at 250° C; −2.1% for liquid at 100° C; −5.1% for liquid at 0° C; −5.9% for liquid at −15°; −8.4% for ice at 0°; and −9% for ice at −20°. This environmental sensitivity of water spectra, attributed primarily to inter-molecular H-bonding, is 25 to 30 times that observed for similar near infrared spectra of CO_2, in which van der Waals forces appear to govern the bulk properties. Author

N65-30181# Atomics International, Canoga Park, Calif.
SOLUBILITY OF BISMUTH IN FUSED BISMUTH CHLORIDE
Yu. K. Delimarsky and Yu. G. Roms Nov. 1964 8 p refs Transl. into ENGLISH from Ukrain. Khim Zhur. (Kiev), v. 30, no. 5, 1964 p 457–460
(AI-TRANS-62)

A study was undertaken to establish the nature of bismuth solubility and to determine quantitatively the degree of solubility of metallic bismuth in $BiCl_3$ at 400° C. The potentiometric method of investigating metal solubility in their salts was used. An assumption was made that bismuth in $BiCl_3$ is in the state of ionized B_2^{2+} dimers. R.N.A.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-29143*# Westinghouse Electric Corp., Baltimore, Md.
FM RECEIVER, RE TEST CONSOLE, APPENDIX I Final Report
S. Andrzejewski 30 Oct. 1964 60 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950144)
(NASA-CR-63909, Append. I) CFSTI: HC $3.00/MF $0.50 CSCL 09F

The various units that make up the FM receiver are analyzed. These include three easily interchangeable bandpass filters which have halfpower bandwidths within ±2% of 1 Mc, 100 kc, and 10 kc, and an amplitude of no more than 0.2 db peak-to-peak ripple across the bandwidth. Also described is a hard limiter having a dynamic range consistent with the signal/noise mixer, and waveform characteristics consistent with the FM detectors which follow it. The phase lock detector has an oscillator center frequency of exactly 50 mc; a loop gain stability of ±5% over all operating conditions; and three standard loop information bandwidths of 3, 30, and 300 kc. Specifications for a conventional FM detector and an output lowpass filter are also given. C.T.C.

N65-29170# Weapons Research Establishment (Australia).
AERIALS FOR SKYWAVES HAVING LOW ELEVATION ANGLES
R. F. Treharne May 1964 19 p refs
(CPD(T)-110)

The use of vertically polarized aerials for the transmission and reception of skywaves having low elevation angles is discussed. Several new types of h.f. aerial are suggested, including a vertical log periodic cartwheel array. Author

N65-29184# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
PHASE AND AMPLITUDE DIVERSITY IN OVER-WATER TRANSMISSIONS AT TWO MICROWAVE FREQUENCIES
H. B. Janes, A. W. Kirkpatrick, D. M. Waters, and D. Smith 12 Apr. 1965 66 p refs
(NBS-TN-307) GPO: $0.40

Propagation measurements at 9.4 and 9.2 Gc/s were made over a 47 km, line-of-sight, over-water path at Eleuthera Island in the Bahamas. The purpose was to study the signal amplitude and phase variations at the two frequencies, and in particular, the variations in the phase difference and amplitude ratio ("differential amplitude") of the two frequencies. The results include power spectra of phase and phase difference variations (from about 10^{-4} to 4 c/s) and cumulative distributions of amplitude, differential amplitude, and phase difference. Author

N65-29221*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
PM RECEIVER RF TEST CONSOLE, APPENDIX F Final Report
G. R. Vaughan, H. E. Burley, and J. B. Sivley 15 Oct. 1964 137 p Prepared for JPL
(Contractors NAS7-100; JPL-950144)
(NASA-CR-63942, Append. F) CFSTI: HC $4.00/MF $1.00 CSCL 09F

An extensive technical description of the phase-modulation receiver developed in the radio-frequency console program is given. Presented in this report are the block diagram for the receiver, details on the signal and noise power levels throughout the receiver and their relationship to the signal/noise matrices, the correlation between the assumed linear power capabilities of the receiver components and the signal/noise matrices, a description of the tracking loop design, the automatic gain control loop design, and mechanization data on each receiver unit. J.M.D.

N65-29285# Federal Aviation Agency, Washington, D. C. Systems Research and Development Service.
FAA HIGH GAIN AIR/GROUND/AIR VHF/UHF TROPOSCATTER SYSTEM Interim Report
Oscar T. Grann Apr. 1965 49 p refs
(RD-65-40)

This report contains a brief history of experimentation and development effort conducted by the FAA and others in air/ground/air troposcatter communications systems and information as to the Systems Research and Development Service program plans in this area. This report also contains a description of the FAA high gain system hardware with siting information necessary for proper operation. A method for approximating the reliable communications ranges to be achieved from these facilities is also included. Author

N65-29286# Raytheon Co., Wayland, Mass.
TV MOSAIC DISPLAY GENERATOR GROUP Final Report
C. A. Berner Jun. 1965 74 p
(Contract FA-WA-4671)
(RD-65-51)

A developmental television mosaic display generator for the National Airspace System is described. The optimum coverage portions of eight air traffic control radars are combined into a composite picture covering a large surveillance area. Ten air traffic controllers may view any portion of the mosaic area with a movable display "window." Input data to the system is radar video which has been scanconverted from PPI to 945-line television. Gray level photographic slides are used with television cameras in a video blanking generator to select scan-coverted radar video for inclusion in the mosaic. Timing for the system is generated by a digital master synchronizer which is fully compatible with existing RBDE-5 equipment. Improved air traffic control methods are developed using the TV mosaic to advance the safe and efficient movement of air vehicles in the Nation's airspace. Author

N65-29374*# Martin Co., Orlando, Fla.
PROPAGATION OF MILLIMETER AND SUBMILLIMETER WAVES Final Report, 17 Jun. 1964–17 Jun. 1965
L. Frenkel and E. P. Valkenburg Jul. 1965 70 p refs
(Contract NASw-963)
(NASA-CR-63994; OR-6607) CFSTI: HC $3.00/MF $0.75 CSCL 17B

Spectrographic studies of the resonant peaks of molecular species in volved in submillimeter wave propagation; and studies of the off-resonant regions of the absorption spectra of atmospheric gases at frequencies up to 300-Gc, are reported. Described is the development of a compact instrument which is based upon the principles of Fabry-Perot interferometry, and which was used in laboratory studies of nonresonant dielectric behavior. Also described is a new method for evaluating linewidth parameters. Presented are results of absorption measurements in H_2O and its mixtures in the frequency region between 150- and 300-Gc; preliminary results for oxygen which indicate that H_2O–O_2 mixtures do not behave in an anomalous manner; and results of low pressure spectroscopic studies of O_2, H_2O, and NO_2. Included is a critical survey of existing data on atmospheric absorption. It is recommended that the program goals be broadened to include mission related phenomena; and that related programs be initiated to provide the necessary instrumentation and components for obtaining quantitative monochromatic absorption data in the region from 500 to 100 Gc. S.C.W.

N65-29375*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
METHODS FOR OBTAINING VELOCITY AND RANGE INFORMATION FROM CW RADARS
Mahlon F. Easterling [1964] 43 p refs Presented at the AGARD 8th Avionics Panel Symp., London, 21–25 Sep. 1964
(Contract NAS7-100)
(NASA-TM-X-54712) CFSTI: HC $2.00/MF $0.50 CSCL 17I

Methods by which a cw radar may be used to measure radial velocity and range for both coherent and noncoherent returned signals are presented. Results of tracking operations are given for each method. It was shown that if the returned signal is coherent and strong enough to be tracked by a phase-locked loop receiver, a cw radar can determine the radial velocity to a fraction of a centimeter per second. If the returned signal is not coherent, the radial velocity can be determined to a few centimeters per second. Techniques for measuring range when the returned signal is noncoherent were applied only to celestial bodies. The accuracies achieved, 150 meters for the moon and 2 km for Venus, were limited primarily by the roughness of the target and the digit period needed to obtain the necessary reflecting surface on the target. The noncoherent method when applied to transponding spacecraft should achieve higher accuracy. L.S.

N65-29376*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE USE OF A UNIVAC 490 AS A REAL-TIME MESSAGE SWITCHING UNIT
R. H. Plaumann [1964] 14 p Presented to Univac Users Assoc., New York, 14–16 Sep. 1964
(NASA-TM-X-54710) CFSTI: HC $1.00/MF $0.50 CSCL 17B

Basic operations of a real-time message switching unit which provides real-time, reliable communication for both data and

teletype messages are explained. The system configuration consists of two Univac 490 central processor units, FH880 drums, III Mag tape units and a 1004 card processor and printer. The system is completely redundant in all respects. A brief description of the NASA Communication Division function, history, and scope is also presented. N.E.A.

N65-29385*# National Aeronautics and Space Administration, Washington, D. C.
NASA SPACE ELECTRONICS RESEARCH
G. A. Vacca [1964] 22 p Presented at the Inter-Am. Symp. on Space Res., Buenos Aires, 3–7 Aug. 1964
(NASA-TM-X-51950) CFSTI: HC $1.00/MF $0.50 CSCL 17G

Recent research in space electronics, by NASA, will be discussed under two categories: 1) Guidance and Control, and 2) Communications; Instrumentation and Data Processing. In the first category, subjects such as the cryogenic gyroscope, the electrostatic accelerometer, gravity gradient stabilization and flight simulation will be discussed. In the second category, the discussion will concern advances in astrophysical instrumentation, on board and ground data processing, laser communications and data transmission and reception. Author

N65-29404*# Society of Photographic Scientists and Engineers, Washington, D. C.
INDEPENDENT TRACKING COORDINATION PROGRAM Quarterly Report No. 5
30 Jun. 1964 147 p
(Grant NsG-35-60)
(NASA-CR-58607) CFSTI: HC $4.00/MF $1.00 CSCL 07I

Summarized are activities and continuing research programs of the Independent Tracking Coordination Program. Reported are: phototrack observations received at SPACON and observations received from independent tracking sources overseas; acquisition data (mean orbital elements and daily satellite ephemerides); rationalized tables of trigonometric functions for use in simplifying desk calculator tracking methods; derivations of rationalized orbital elements from daily satellite ephemerides, SATOR code messages, and NORAD/SPADATS 4-line elements; rules for computing rationalized orbital elements for a new epoch, for error-free combination of polar angles, and for obtaining the negative of an angle; a digital computer program for predicting positions of artificial earth satellites at the point of local culmination; long-term tracking techniques for stable satellites; requirements for passive geodetic satellites; and matrix methods. Included are work sheets, tables, and published data. S.C.W.

N65-29461*# Stanford Univ., Calif.
A NEW VLF PHENOMENON: WHISTLERS TRAPPED BELOW THE PROTONOSPHERE
D. L. Carpenter, N. Dunckel, J. F. Walkup [1964] 26 p refs Submitted for Publication
(Contract NAS5-2131; Grants NsG-174-61; NSF-17037; NSF GP-1191)
(NASA-CR-58255) CFSTI: HC $2.00/MF $0.50 CSCL 20N

A new whistler phenomenon has been identified through measurements at ground stations on an Aerobee rocket between 100 and 200 km, and on the Alouette satellite at 100 km. The new phenomenon is called the "sub-protonospheric" or "SP" whistler, since most of its path appears to be restricted to the region below about 1000 km. In the present report a large number of observations are summarized and the basic characteristics of the new phenomenon are described. Experimental results are presented which suggest that the whistler ray path is confined to the region between roughly 100 km and 1000 km altitude, and that the whistler energy can echo back and forth between these levels. The SP phenomenon occurs mostly at night, typically within a few hours after sunset. SP events are often observed over a period of one or two hours in duration and, for a single Alouette pass, have been observed over a north-south range as great as 2000 km in extent. The evidence suggests that the SP phenomenon occurs mostly near sunspot minimum and at dipole latitudes greater than 45 degrees. Author

N65-29616# Texas Instruments, Inc., Dallas.
LOW-NOISE L-BAND AMPLIFIER Quarterly Progress Report No. 3, 1 Dec. 1964–28 Feb. 1965
Leslie W. Read, George D. Johnson, Roger R. Webster, and R. L. Petritz [1965] 35 p refs
(Contract DA-28-043-AMC-00109(E))
(TI-03-65-33; AD-616331)

The Third Quarterly Report presents work in single-stage and three-stage transistor amplifier design and construction. *Device Characterization*: Common-base measured Y parameters on recent L-78A devices are presented. The possibility of using common emitter is being reviewed because of recent improvements in device performance. *Single-Stage Amplifiers*: The gain of the single-stage amplifiers is now relatively predictable from measured Y parameters, using the Linvill charts. The common-base L-78A transistors give typically 8 to 13 db of gain at about 1.3 Gc with −3 db bandwidths ranging from 400 to 110 Mc in a microstrip circuit. The noise figures of the single stages are 4.5 to 5 db. The minimum corrected noise figure varies with load: the lowest measured noise figure occurs when the gain is highest. This variation with load is not in agreement with theory, and the cause of this variation is being investigated. *Three-Stage Amplifiers*: A three-stage amplifier breadboard has been constructed which meets the gain-bandwidth design objectives. The noise figure is 5.8 db, in good agreement with the calculated value of 5.5 db. Phase shift on the amplifier will be measured when a phase measurement test set now on order is delivered. Earlier measurements using borrowed equipment have indicated that this will not be a severe problem. Author

N65-29617# Harvard Univ., Cambridge, Mass. Cruft Lab.
THE LONG YAGI-UDA ARRAY
Robert J. Mailloux 30 Mar. 1965 73 p refs
(Contract Nonr-1866(32); Grant NSF GP-851)
(TR-464; AD-615803)

The King-Sandler array theory is used to analyze the excitation of a surface wave along a semi-infinite Yagi array, as well as the scattering of such a wave at the end of the array. A method for approximately analyzing the behavior of finite Yagi arrays is presented which involves the matching of two terminal-zone problems for semi-infinite arrays. Before attempting to correlate the new theory with the more rigorous array theory, an experimental study of a twenty-element Yagi array was undertaken, and all results are shown to be accurately predicted by the King-Sandler theory. An extensive set of numerical data is presented to compare wave theory with array theory, and once again the agreement is excellent. Finally, the new theory is shown to predict a certain critical point in the data at which the wave solution ceases to exist. This point is also observed to enter dramatically into the King-Sandler solution, thus providing a final contribution to the evidence which links the wave theory to the accepted King-Sandler theory. Author

N65-29619# Naval Air Test Center, Patuxent River, Md. Weapons Systems Test Div.
INVESTIGATION OF FILTER CHARACTERISTICS OF ARRAYED CONDUCTORS BETWEEN GROUND PLANES Interim Report
P. V. Roberts 15 Jun. 1965 17 p
(AD-616239)

An interdigital line filter was designed, manufactured, and investigated. The band-pass characteristics indicate that the filter has an extremely sharp cutoff which would be useful in the measurement of spectrum signatures. Author

N65-29621# Marine Corps Landing Force Development Center, Quantico, Va.

HELICOPTER HIGH FREQUENCY SINGLE SIDE-BAND ANTENNA INVESTIGATION

[1965] 37 p

(AD-462955)

1. An investigation and subsequent evaluation of various HF SSB state of the art antenna systems was conducted to provide Marine Corps helicopters with gapless 0-100 mile communication capability at 500 foot altitudes. 2. Based on the results of numerous tests, it is concluded that a Helical Monopole type antenna mounted on a UH-34D helicopter is as effective a vertical radiator as a 16 foot whip mounted on a AN/MRC-87. 3. The use of the Helical Monopole antenna will offer a definite advantage when used for propagating HF ground wave signals which should be vertically polarized to accomplish the desired 0-100 miles gapless communications. Author

N65-29676*# Massachusetts Inst. of Tech., Cambridge.

DIGITAL COMMUNICATION OVER FIXED TIME-CONTINUOUS CHANNELS WITH MEMORY: WITH SPECIAL APPLICATION TO TELEPHONE CHANNELS

J. L. Holsinger (Ph.D. Thesis) 20 Oct. 1964 134 p refs

Its Res. Lab. of Electron Tech. Rept. 430; Lincoln Lab. Tech. Rept. 430

(Grants NsG-334; NsG-496; NSF GP-2495; NIH-MH-04737-04; Contracts DA-36-039-AMC-03200(E) et al)

(NASA-CR-64056) CFSTI: HC $4.00/MF $1.00 CSCL 17B

The objective of this study is to determine the performance, or a bound on the performance, of the "best possible" method for digital communication over fixed time-continuous channels with memory, i.e., channels with intersymbol interference and/or colored noise. The channel model assumed is a linear, time-invariant filter followed by additive, colored Gaussian noise. Two questions are considered: (1) given a set of signals, what is the probability of error? and (2) how should these signals be selected to minimize the probability of error? It is shown that answers to these questions are possible when a suitable vector space representation is used, and the basis functions required for this representation are presented. A bound on the probability of error for a random ensemble of signals is determined and the structure of the ensemble of signals yielding a minimum error bound is derived. The inter-relation of coding and modulation in this analysis is discussed and it is concluded that: (1) the optimum ensemble of signals involves an impractical modulation technique, and (2) the error bound for the optimum ensemble of signals provides a "best possible" result against which more practical modulation techniques may be compared. Subsequently, several suboptimum modulation techniques are considered. Author

N65-29711# Weapons Research Establishment (Australia).

"PEDESTAL" DOPPLER AT THE WOMERA RANGE

A. A. Smith Mar. 1965 29 p

(WRE-TN-ISD-46)

The method of applying a 'pedestal' frequency to Doppler system frequencies in use at Woomera is given. Electrical circuits for a velocity indicator and other associated items are included. Author

N65-29720*# Space Technology Labs., Inc., Los Angeles, Calif.

COHERENT FDM/FM TELEPHONE COMMUNICATIONS

Jean A. Develet, Jr. 1 Jan. 1962 38 p refs

(Contract NAS5-1302)

(NASA-CR-64039; STL-8614-6004-NU-000) CFSTI: HC $2.00/MF $0.50 CSCL 17B

This paper analyzes telephone communication as applied to a satellite repeater system. In particular, emphasis is placed on a method of coherent reception which is important to our emerging communication satellite systems. This reception technique is not new to the field of space communications and telemetry; however, it is new to the field of common carrier telephony. As a consequence, for the class of signals utilized in common carrier telephony, an attempt is made to place on a quantitative footing the design of FDM/FM satellite communication systems. The interrelation among such quantities as sensitivity, bandwidth occupancy, and channel quality is presented for a simply realized second-order receiving system. In addition, the maximum sensitivity achievable with the optimum receiving system is shown. It is anticipated these two situations will bound the performance of the majority of systems. Author

N65-29748*# RAND Corp., Santa Monica, Calif.

HARD LIMITING OF THREE AND FOUR SINUSOIDAL SIGNALS

William Sollfrey Jul. 1965 32 p refs

(Contract NASr-21)

(NASA-CR-64012; RM-4653-NASA) CFSTI: HC $2.00/MF $0.50 CSCL 17B

An analysis has been performed of the effect of hard limiting on a sum of three or four sinusoidal signals. Expressions are obtained for the output amplitudes for three input signals, two of equal amplitude, and for four signals, amplitudes equal in pairs. The answers are compared with experiment and display excellent agreement. The results indicate the general character of the reduction of the suppressive effects of limiting as the number of signals increases. Also, "negative suppression" occurs for certain amplitude ranges. Author

N65-29807*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MANNED SPACE FLIGHT NETWORK POSTMISSION REPORT FOR RANGER C AND D

26 Jul. 1965 12 p

(NASA-TM-X-55243; X-552-65-307) CFSTI: HC $1.00/MF $0.50 CSCL 17B

Coverage of the orbital portions of the Ranger C and D missions through loss of signal (LOS) is analyzed. A brief critique of the performance of the Manned Space Flight Network (MSFN) for the two missions is presented with emphasis on troubles experienced. The general network requirements were to provide real-time computation support through injection and LOS, to provide C-band radar beacon tracking through LOS, and to receive and record the Agena telemetry link until battery decay or retromanuever. All of the MSFN stations that participated in the missions are listed. The network mission preparations are reviewed, and the performance of the basic on-station systems and the computing and ground communications systems are summarized. R.N.A.

N65-29846*# National Aeronautics and Space Administration, Washington, D. C.
SPACE COMMUNICATIONS: THEORY AND APPLICATIONS. VOL. 2: CODING AND DETECTION THEORY Bibliography, 1958–1963
Richard F. Filipowsky and Louise C. Bickford, comp. Jun. 1965 426 p refs
(NASA-SP-7022(02)) GPO: $2.25; CFSTI: MF $2.25 CSCL 17B

An annotated bibliography is presented on coding and detection theory for space communications. Literature is included on the fundamentals of coding, fundamentals of information compression and discrete data compaction, audio and video compression, multiplexing of channels and facilities, protective coding, detection theory, and controlled communications systems. R.N.A.

N65-29869# DECO Electronics, Inc., Boulder, Colo.
10 KC/S ATMOSPHERIC NOISE PREDICTIONS
E. L. Maxwell and D. L. Stone May 1965 57 p refs
(Contract Nonr-4107(00))
(Rept.-54-F-2; AD-615923)

This report contains a full set of atmospheric noise prediction maps for 10 kc/s. The procedure involved in transferring the 1 megacycle maps given for local time and seasonal periods in CCIR Report 322 to 10 kc/s maps given in Universal Time for three month periods is described in this report. A new approach to the prediction of VLF atmospheric noise was begun under this program and preliminary results are presented herein. The presentation of the CCIR data on a universal worldwide scale for a particular three month period revealed serious shortcomings and obvious disagreements with noise source and VLF propagation characteristics. The new technique begun makes direct use of noise source and propagation information. The preliminary results indicate that this technique may offer considerable advantages in the VLF range. Author

N65-29873# Aerojet-General Corp., Azusa, Calif.
SPATIAL FILTER SYNTHESIS ANALYSIS Final Report
29 Jan. 1965 13 p refs
(Contract Nonr-4556(00); ARPA Order 369; Proj. Defender)
(Rept.-2985; AD-610727)

This report discusses the design and synthesis of low-pass and band-pass one-dimensional and two-dimensional spatial filters using arrays or matrices of detectors. The synthesis was performed for alternate assumptions of negligible and significant detector gaps. The detector width and the detector weighting functions are the two optimized parameters. A frequency analyzer, using a narrow-band one-dimensional filter, was designed and simulated. Tests indicated performance as expected. Author

N65-29955*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO USB-SYSTEM: MULTISIGNAL PHASE MODULATION PROBLEMS AND SOLUTIONS
B. Kruger 21 Apr. 1965 48 p refs
(NASA-TM-X-55270; X-513-65-211) CFSTI: HC $2.00/MF $0.50 CSCL 20N

The spectrum of a phase modulated carrier is analyzed. The analysis is based on the RMS phase deviation only, so that knowledge of the frequency spectrum of the modulating time function is not required. Upper and lower limits of the amplitudes of the spectral components of the phase modulated carrier are derived at, the main emphasis being given to the component of carrier frequency. The usefulness and simplicity of the equations derived is demonstrated in the analysis of a carrier phase modulated by a pseudo random code and two phase modulated subcarriers. The calculations are carried out without introducing approximations such as substituting voice or other information by a single frequency. Author

N65-29973# Raytheon Co., Norwood, Mass.
RADIO PROPAGATION VIA SUBSURFACE ROCK STRATA Final Report, Oct. 1962–Mar. 1965
Carson K. H. Tsao Apr. 1965 60 p refs
(Contract AF 19(628)-2362)
(AFCRL-65-299; AD-615785)

Experiments in the transmission of radio waves through subsurface rock strata were conducted on Cape Cod, Massachusetts, in the Adirondack region of New York, and in the Cheyenne Mountain area of Colorado. Linear vertical antennas were placed in deep drill holes. The transmission path lengths were 1 mile on Cape Cod and 1 and 3 miles in the Adirondack region. At Cheyenne Mountain, where the up-over mode was emphasized, the path through the rock was approximately 700 feet. The subsurface media encountered in these areas were found to be quite inhomogeneous, and on the whole, to have relatively high values of conductivity, larger than 10^{-4} mhos/meter. Several techniques were used to ascertain whether the transmissions were due to radio waves propagating directly through the rock strata or via the "up-over-and-down" path. The bulk conductivities of the rock media along the transmission paths were deduced from measurements of the attenuation and the phase constants. The local conductivities in the vicinity of the drill holes were deduced from the measured impedance characteristics of the antennas. An improved antenna probe technique was used to determine the fine-grain variations of conductivity with depth in the drill holes. Author

N65-29997# Harvard Univ., Cambridge, Mass. Cruft Lab.
OPTIMIZATION OF THE YAGI ARRAY, II Scientific Report No. 10
I. Larry Morris 16 Feb. 1965 71 p refs
(Contract AF 19(628)-2406; Grant NSF GP-851)
(AFCRL-65-346; AD-616911)

The computer programs for optimizing the Yagi array, which were written in FORTRAN for the IBM 7094 computer, are discussed in detail. These programs employ the modified quasi-zero-order theory as well as certain techniques which reduce the execution time and facilitate the reduction of data. Typical printout from the four options of the main program is also included. Detailed investigations of the 1- and 4-director Yagi arrays (with directors of constant length, radius, and spacing) are summarized in the form of contour maps for forward gain, backward gain, front-to-back ratio, input resistance, and input reactance. Horizontal field patterns and vector diagrams are presented for 1-, 2-, and 4-director arrays having maxima in forward gain or front-to-back ratio. The method used to search for these maxima is outlined. With the director length fixed at 0.43λ, a comparison is made between the 1-, 2-, 4-, and 8-director Yagi arrays. Author

N65-30026# Federal Aviation Agency, Atlantic City, N. J.
EVALUATION OF ATCBI DECODER MODIFICATIONS Final Report
Robert A. Waldmann May 1965 57 p
(RD-65-59)

A set of prototype modifications to the decoders of Air Traffic Control Radar Beacon Ground Station, Types ATCBI-2 and ATCBI-3, were evaluated to ensure validity of the design of the modifications as a basis for a product specification. Tests of the modifications to the ATCBI-2 decoder were conducted at the National Aviation Facilities Experimental Center

(NAFEC), Atlantic City, New Jersey; tests of the modifications to the ATCBI-3 decoder were conducted at the Atlanta Airport Traffic Control Tower, Atlanta, Georgia. The modifications were designed primarily to detect and process emergency (code 7700) replies, communications-failure (code 7600) replies, and four-train (military) emergency replies. The Whittaker Corporation, North Hollywood, California, designed and installed the modifications under Contract FA-WA-4706. Performance of the modified decoders was observed in order to support estimates of the ability to decode properly a valid emergency reply, communication-failure reply, or four-train emergency reply, occurring in a live operational environment. False alarm rates were investigated under various operating conditions. It was concluded that the basic design of the modifications was valid and, with certain improvements could serve as the basis for a product specification. It was recommended that the basic design be adopted as the basis for the product specification and the modifications be implemented by means of field modification kits. It was also recommended that final acceptance and implementation in the field be contingent upon a practical demonstration that the alignment procedures, supplied with the production modifications, are satisfactory. Author

N65-30029# Naval Postgraduate School, Monterey, Calif.
A STUDY OF THE SPECTRAL CHARACTERISTICS OF PULSE-POSITION MODULATED WAVEFORMS
Arthur Augustus Bergman (M.S. Thesis) 1964 97 p refs

The power spectral density of a pulse-position modulated waveform is determined in part by certain statistics of the modulating process. A mathematical model is developed to determine the effects of three different modulating processes upon the power spectral density. The processes considered are the Gaussian, the exponential, and the uniform processes, with statistical independence assumed between the sample values that modulate the waveform. The Gaussian process is also developed for the case in which statistical independence may not be assumed; that is, a correlation exists between the sample values of the modulating process. The model will also determine the power spectral density of pulse-amplitude modulated waveforms. The mathematical model is reduced to a computer model and computed results are displayed. The design of a pulse-position modulator is shown, and experimental measurements of power spectra are compared with the theoretically determined spectra. The theoretical determination of power spectral density and the actual measurement of spectra of finite-time samples are discussed. Author

N65-30045# Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
INTEGRATED RADIATORS STUDY AND INVESTIGATION Final Report, 26 Dec. 1963–26 Dec. 1964
E. Murphy, D. R. Wehner, J. B. Mac Dougall, and P. L. Shelton Griffiss AFB, N. Y., RADC, Apr. 1965 102 p refs
(Contract AF 30(602)-3270)
(RADC-TR-65-44; AD-616356)

This report describes the results of a twelve-month study of techniques in integrated radiator design. This study at UHF has resulted in theoretical analysis and experimental evaluations of integrated radiator techniques. These techniques involve the integration of active solid state devices into radiating structures to improve the physical and electrical characteristics of a device capable of one or more functions. This device, or functional component, can provide improved gain, bandwidth, or other desirable electrical characteristic while requiring a smaller volume and fewer components and interconnections. In this investigation several classes of radiators were carefully selected for integration with various solid state devices. The techniques developed during the study represent a number of different basic integrated radiator concepts. Using these basic concepts as a basis, other, more advanced integrated radiators can now be developed. Author

N65-30084# Royal Aircraft Establishment, Farnborough (England).
DIURNAL CHANGES IN TRANSMISSION TIME FOR V.L.F. SKYWAVE SIGNALS
W. T. Blackband London, Min. of Aviation, Mar. 1962 25 p refs
(RAE-TN-RAD-816)

Experimental data are presented for the diurnal changes in transmission time (Δt) for over 40 different paths. The dependence of Δt upon distance from the transmitter is discussed and the experimental data are shown to be in qualitative agreement with simple physical pictures in terms of geometrical optics or waveguide propagation. It is shown that Δt is dependent on frequency with a broad minimum at 16 Kc/s, but that there is no marked dependence on direction of propagation. Author

N65-30121# Ohio State Univ., Columbus. Research Foundation.
A TECHNIQUE FOR ACHIEVING VERY HIGH ANTENNA GAIN. THE ADAPTIVELY PHASED ARRAY Final Report, Jan. 1960–Dec. 1964
James W. Bailey Griffiss AFB, N. Y., RADC, Jun. 1965 42 p refs
(Contract AF 30(602)-2166)
(RADC-TR-65-108; AD-617751)

The design considerations of a phased array antenna system are given. The antenna was designed to demonstrate the adaptive phasing principle as applied to achieving high antenna gain in a communication satellite environment. Factors such as phase perturbances, signal distribution within the array, array bandwidth and pattern control are considered. An adaptively phased array consisting of four thirty-foot parabolic reflectors is described. Additionally the results obtained from the array in regard to signal-to-noise improvement as obtained in experiments with Echo II as well as signature studies of Echo II signals are described. Author

N65-30122# Colorado Univ., Boulder.
FIELD STRENGTH MEASUREMENTS IN A MULTIPATH FIELD USING LINEAR AND CIRCULAR PROBING Interim Report, Nov. 1964–Feb. 1965
Raj Mittra and C. O. Stearns Griffiss AFB, N. Y. RADC Jun. 1965 45 p refs Prepared jointly with Nat. Bur. of Standards, Boulder, Colo.
(Contract AF 30(602)-2936)
(RADC-TR-65-114; AD-617781)

Techniques for resolving the components of a multipath field are investigated in this report. Both linear and circular probing schemes are discussed. Two methods for analyzing the linearity probed data are given, which are considerably simpler than the procedure followed by Watterson in an earlier report. One of these is extended to the circular case. It is found that the resolution in the circular case is substantially poorer than for the linear scheme. Author

N65-30135# Mitre Corp., Bedford, Mass.
THE DESIGN OF RADAR SIGNALS
E. N. Fowle Jun. 1965 196 p refs
(Contract AF 19(628)-2390)
(SR-98; ESD-TR-65-97; AD-617711)

This report discusses the design of radar signals. It is assumed that the radar receiver is matched to the signal so that the receiver output waveform, in the presence of signal Doppler frequency shift, is characterized by Woodward's two-dimensional signal correlation function. The signal correlation function is discussed, and certain of its properties are collected together. The problem of the detection of a target in the presence of many nearby targets is discussed, and an expression for the target capacity of a radar is developed in terms of the signal correlation function. There follows a discussion of the general problems of signal design for multiple target resolution and for detection of single targets in clutter. Signal waveforms are classified according to the type of modulation, and the design of waveforms of each type is considered in detail. The two-dimensional correlation function is given for each type of signal. Finally, the subject of techniques for generation and reception of signals is discussed. Author

N65-30145# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
AN ADAPTIVELY PHASED, FOUR-ELEMENT ARRAY OF THIRTY-FOOT PARABOLIC REFLECTORS FOR PASSIVE (ECHO) COMMUNICATION SYSTEMS Interim Technical Report, Jan. 1964–Jan. 1965
Jon W. Eberle Griffiss AFB, N. Y., RADC, Jun. 1965 220 p refs
(Contract AF 30(602)-2166)
(RADC-TR-65-69; AD-617750)

This report describes an array of four, thirty-foot diameter independently steerable antennas designed to operate in a passive communications satellite environment. The array is adaptively placed to provide signal coherence and combining prior to detection. An analysis is presented of the various phase-locked loops in the array. The modes of operation and the design considerations for the array are discussed in detail. Results of operating the array with Echo I, Echo II, and the moon are presented and discussed. Author

N65-30158# Air Force Cambridge Research Labs., Bedford, Mass
ON THE RESOLVING POWER OF GROUND MAPPING RADAR ANTENNAS
J. F. Mc Ilvenna and C. J. Drane, Jr. May 1965 57 p refs *Its* Phys. Sci. Res. Papers No. 104
(AFCRL-65-322; AD-617254)

The mapping of extended, cultural ground targets by an airborne radar is examined using communication theory concepts including those of the antenna transfer function and the target spatial frequency spectrum. Use of the set of transfer functions that correspond to Taylor aperture distributions and specification of the targets directly in terms of their spatial frequency spectra, permits one to examine the antenna images for quality and resolution. The results obtained indicate that resolution for a class of ground targets can be much better than is predicted by the two-point Rayleigh resolution criterion. It is also true that there can be situations in which the shape of the antenna images are quite independent of the radiation pattern. Several types of spatial noise were also included in the input spectrum to investigate noise effects on image quality and resolution. Author

N65-30183# New York Univ., N. Y. Research Div.
ANTENNA TEST EQUIPMENT WITH MILITARY NOMENCLATURE ASSIGNMENTS
Harrison A. G. Stone Jan. 1964 19 p
(Proj. Sete)
(Sete-210/70)

General purpose instruments are commonly employed in laboratory situations and in the field, for the evaluation of many antenna parameters primarily upon a go–no–go basis. Among the instruments categorized are: (1) instruments and equipments intended for measurements peculiar to antenna and radiating device problems and applicable for general purpose use with a wide variety of antennas without regard to the utilization of the antennas in their equipment systems; and (2) instruments designed to perform specific tests upon specific antenna equipments as part of, or in conjunction with, their employment in a particular equipment system. R.W.H.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-29189*# Maryland Univ., College Park. Computer Science Center.
PATTERN RECOGNITION: IV. SEQUENTIAL OPERATIONS IN DIGITAL PICTURE PROCESSING
Azriel Rosenfeld and John L. Pfaltz May 1965 66 p refs
(Grant NsG-398)
(NASA-CR-63948; TR-65-18) CFSTI: HC $3.00/MF $0.75 CSCL 14E

A sequential approach to digital picture processing is discussed. The study suggests that local operations performed on picture elements taken in a definite sequence, using at each step the results obtained by operating on the preceding elements in the sequence, are preferable to the parallel approach. Sequential local operations for performing two basic picture transformations are described. The first labels the connected components of any given picture subset, while the second determines the distance from every picture element to the nearest element of a given subset. A skeleton subset is defined for use in place of the given subset to generate the same transformed picture by applying the reverse local operations sequentially. Output examples of sequential computer programs which perform these transformations are given. Programs are described which construct graphs corresponding to dissections of a picture into regions and which determine the orders of connectivity of the multiply connected regions. Two approaches to discriminating elongated from nonelongated regions or parts of regions using the distance transformation are presented. R.N.A.

N65-29194# Library of Congress, Washington, D. C. Aerospace Technology Div.
COMPUTER TECHNOLOGY Surveys of Soviet-Bloc Scientific and Technical Literature
13 Jul. 1965 48 p refs Compilation of Abstracts
(ATD-P-65-50; AD-466287)

A compilation of abstracts on Soviet computer technology is presented. Areas considered are components, design, applications, and associated systems; a bibliography is also included. C.T.C.

N65-29212# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
I.S.U. GUTS SYSTEM FOR KINEMATICAL ANALYSIS OF BUBBLE CHAMBER DATA
William J. Kernan, William J. Higby, and Iva H. Boessenroth Nov. 1964 82 p refs
(Contract W-7405-ENG-82)
(IS-1072) CFSTI: $3.00

This paper is a description of the I.S.U. GUTS system for the kinematical analysis of bubble chamber data. As better methods of treating certain aspects of this problem are developed, we are occasionally updating this system. The present version of GUTS discussed here is Version III. Author

N65-29412*# National Aeronautics and Space Administration. Goddard Space Flight Center
NASCOM SYSTEM PROGRAMMING
J. D. Picot [1964] 7 p Presented to the Univac Users Assoc., New York, 14–16 Sep. 1964
(NASA-TM-X-54731) CFSTI: HC $1.00/MF $0.50 CSCL 09B

Major considerations in organizing the programing for the NASA World-Wide Communications Network (NASCOM) included the time frame involved, education of personnel, record keeping, and future capability of the system. The key to the system is a high speed drum which permits all parts of the program to operate independently. Control can be passed to other parts of the program by entries on queues. The queueing concept allows a program to handle events one at a time, even though they happen simultaneously. Automatic compensation for speed differences between input and output is possible and the need for coordinating output to different circuits is eliminated. M.W.R.

N65-29469*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS-GODDARD NASA PERT PROGRAMS IN COMPILER LANGUAGE
Elizabeth Ryan and Ross C. Bainbridge 19 May 1964 21 p Presented at the NASA Ind. PERT Computer Conf., Houston, Tex., 22 Jul. 1964
(NASA-TM-X-51937) CFSTI: HC $1.00/MF $0.50 CSCL 09B

A PERT time program written in compiler language with a capacity in excess of 30000 activities is under study. With the ability to place time estimates into an output form with activity times that truly reflect the interrelations of the base network, a method of upward reporting was established. R.W.H.

N65-29484*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PERFECT PUNCTURED CYCLIC CODES
G. Solomon and J. J. Stiffler [1964] 19 p Presented at the Intern. Conf. of Microwave Circuit Theory and Inform. Theory, Tokyo, 7–11 Sep. 1964
(NASA-CR-59048) CFSTI: HC $1.00/MF $0.50 CSCL 09B

A class of codes which were obtained from maximal length shift register codes by deleting or puncturing certain of their coordinates are presented. The punctured cyclic codes obtained were shown to be optimum, and an encoding and decoding procedure was outlined. A new bound on the maximum distance obtainable with an n, k group code was derived with the demonstration of the optimality of these codes. This bound compared favorably with the well known Plotkin bound. R.W.H.

N65-29627# Royal Aircraft Establishment, Farnborough (England).
AN ARITHMETIC UNIT MADE WITH SURFACE BARRIER TRANSISTORS IN DIRECT COUPLED LOGIC
T. R. H. Sizer Jan. 1962 46 p refs
(RAE-TN-IAP-1118)

The arithmetic unit of CORSAIR, a d.d.a., is described after reference to the principle of operation of a d.d.a. In an Appendix a basic logical element is described consisting of a single transistor in a common emitter configuration. Using this, the detailed design of the arithmetic unit is explained and complete details given of the various circuit configurations. Author

N65-29630# Royal Aircraft Establishment, Farnborough (England).
CORSAIR, A DIGITAL DIFFERENTIAL ANALYSER
P. L. Owen, M. F. Partridge, and T. R. H. Sizer London, Min. of Aviation, Dec. 1960 39 p refs
(RAE-TN-IAP-1123)

This note describes a digital differential analyser "CORSAIR" which was designed and built at the Royal Aircraft Establishment. A short introduction to the general subject of d.d.a's is given followed by a detailed description of the logical design of this particular machine and its realisation in terms of circuit elements. Circuit diagrams are not given. The mechanical form of the computer is described and photographs of the internal constructions are shown. Author

N65-29631# Royal Aircraft Establishment, Farnborough (England).
THE LOGICAL DESIGN OF AN INCREMENTAL MULTIPLIER AND AN INCREMENTAL DIVIDER USING DIRECTLY COUPLED TRANSISTOR LOGIC
D. W. Partridge London, Min. of Aviation, Apr. 1964 32 p refs
(RAE-TN-IEE-28)

The principles of incremental multiplication and division as carried out by the digital differential analyser are outlined, and the errors described. Incremental equations for multiplication and division which eliminate the truncation errors produced by the digital differential analyser are derived. A description is given of the mechanisation of these equations using directly coupled transistor logic to produce specialised multiplier and divider units. Author

N65-29681*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EPE-D DATA PROCESSING PLAN, VOLUME II
Marc Jay Selig 1 Dec. 1964 67 p
(NASA-TM-X-55241; X-545-64-388) CFSTI: HC $3.00/MF $0.75 CSCL 09B

The staff and organization of the EPE-D data processing plan for acquiring, recording, reducing, editing, storing, and dispensing data on space flights are described in detail. J.M.D.

N65-29801*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPLORER 17 DATA REDUCTION PROGRAM DOCUMENTATION AND REPORT FOR THE PRESSURE DENSITY PROGRAM
Charles Hanley and William Gough 15 Mar. 1965 120 p
(NASA-TM-X-55249; X-543-65-125) CFSTI: HC $4.00/MF $0.75

The Pressure Density Program (PDP) is a digital computer program for processing data consisting of voltage measurements of the neutral atmospheric density and temperature. The problem involves analyses of the data recorded by the Bayard-Alpert (BA 1 & 2) and Redhead (RH 1 & 2) gauges. These four gauges combine to cover the expected 10^{-6} torr to 10^{-11} torr pressure range, and have positioned on satellites. A discussion of the mathematics involved in computing pressure for the BA and RH guages separately is given. Other areas discussed are (1) gauge orientation, (2) structure of the program, (3) subroutines (4) data cards, (5) tape formats, (6) sample program output, and (7) Fortran II listing. N.E.A.

N65-29802*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN IMPROVED APPROACH TO TRACE ROUTINES
Eugene I. Grunby Feb. 1965 59 p
(NASA-TM-X-55247; X-545-65-115) CFSTI: HC $3.00/MF $0.50 CSCL 09B

Despite the value of trace routines, several serious drawbacks have deterred programmers from their use. Perhaps the worst of these are considerably extended execution time and overabundance of printed diagnostic material. Among the secondary problems is the inability of users to provide own-coding subroutines for extended usage. This document proposes a solution to these problems. It also describes usage of the trace routine embodying these improvements for the Univac 1107. N.E.A.

N65-29805*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MUTUAL VISIBILITY COMPUTER PROGRAM FOR COMMUNICATION SATELLITES
G. D. Repass and R. G. Chaplick May 1965 114 p ref
(NASA-TM-X-55271; X-547-65-222) CFSTI: HC $4.00/MF $0.75 CSCL 09B

A Mutual Visibility Computer Program for communication satellites is described for settling problems of scheduling satellite experiments. The program is described as an orbit generator with associated subroutines necessary to perform needed calculations. A brief explanation of how the orbit generator has been programed is given. The computer program is written in Fortran II for the IBM 7094 and is designed typically as a main program with subroutines called when needed. The orbit generator has been designed to compute in one subroutine all quantities which are functions of mean elements and earth constants. Another subroutine computes only those quantities which are either explicit or implicit functions of time. Terms that occur at least twice in the equations are assigned a variable name and actually are computed only once. The results of Main Program One are presented. N.E.A.

N65-29864# Naval Postgraduate School, Monterey, Calif.
A SATELLITE COMPUTER SYSTEM FOR ON-LINE ANALYSIS, CONTROL, AND DISPLAY
George H. Leach and Albert J. Perrella (M.S. Thesis) 1964 170 p refs

This project was undertaken to achieve a problem solving complex based on the Fortran 60 system. A system utilizing a remote computing station with a data processor satellited to the main computer and a cathode ray tube display unit used as a multipurpose input/output control unit has been designed, programmed, and demonstrated. The system features online, variable speed output of both printed output and graphical material presented on the display, parameter change capability in running Fortran programs, complete control of the main computer from the satellite station, simplicity in making additions and changes, and system philosophy adaptable to full scale timesharing on the main computer. In addition, utilizing the equipment in the Electrical Engineering Department Digital Control Laboratory, this system can be extended to provide the capability of digital control of analog systems. Author

N65-29890# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A METHOD OF CHECKING AND CORRECTING COMPUTERS, REPRODUCING GIVEN FUNCTIONS
M. B. Ignat'yev and V. V. Mikhaylov 24 May 1965 12 p refs Transl. into ENGLISH from Sbornik Rabot Voprosam Elektromekhan. Telemekhanizatsiya i Priborostr. (Moscow), no. 9, 1963 p 38–45
(FTD-TT-65-83/1+2; AD-617158)

A method is proposed for checking and correcting computers by reproducing given functions. The given function is considered as a projection of the intersection of multidimensional surfaces. Equations of these surfaces are solved simultaneously by solving the simplest ones and on their basis evaluating the propriety of solving the problem as a whole. R.N.A.

N65-29893# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SMALL SCALE COMPUTER "PROMIN"
V. I. Karpus and Yu. I. Kodzayev [1965] 9 p Transl. into ENGLISH from Mashinostr. (USSR), no. 4, 1964 p 54–57
(FTD-TT-65-453/1+2+4; AD-617119)

The Promin small scale computer is described. The machine is fixed with a set of standard programs including the integration of differential equation systems by the method of quadratures; finding actual roots of transcendental equations and their extremums; Neutonian first interpolation; Chebyshev quadratic interpolation; and finding values of definite integral. The machine is intended for speeds of 30–40 operations per second. The power source, dimensions, component parts (arithmetical, control, memory, programing, and microprograming) and coding system are discussed. L.S.

N65-30064# New York Univ., N. Y. AEC Computing and Applied Mathematics Center.
[COMPUTING AND APPLIED MATHEMATICS] Progress Report No. 33, 1 Jul.–31 Dec. 1964
Robert V. Shevlin 29 Mar. 1965 14 p
(Contract AT (30-1)-1480)
(NYO-1480-16)

Progress is reported for research activities under the general headings of engineering, applied mathematics and mechanics, physics, and computer operations and methods. Diode core and high density speed core memories are discussed, and a prototype 4-word, 16-bit per word memory was tested. A prototype nondestructive read magnetic-core module was debugged and operated, and work has been done on a 24-bit adder–subtractor using current switching logic. Ferrite powders, ferromagnetic devices, and continuous wire-plating are under investigation. Studies were made in the fields of fluid mechanics, elasticity, classical statistical mechanics, and quantum mechanical few- and many body problems, as well as practical programming activities. Work on algebraic manipulation routines was continued, a tentative theory of pattern recognition was formulated, and a theorem prover was written in LISP for the IBM 7094. M.W.R.

N65-30066# Union Carbide Nuclear Co., Oak Ridge, Tenn. Oak Ridge Gaseous Diffusion Plant.
TABLE LOOK-UP TECHNIQUES FOR COMPUTER PROGRAMMING
C. E. Price 13 May 1965 12 p
(Contract W-7405-ENG-26)
(K-DP-515)

Techniques for looking up information in a table from a computer programming standpoint are described. These include: (1) *The Sequential Search*—The data item key is compared with each table item key until a match is found at all table positions. (2) *The Merge Search*—Actually a sequential search technique, this requires that the table and data be ordered or sorted in the same sequence on the key involved. (3) *The Binary Search*—This position-related technique provides that each look into the table finds the key in question or eliminates half of the table positions. (4) *The Formula Search*—This technique introduces the concept of key–position related methods. (5) *The Computed Position Look-up*—This relation must be determined or known in advance of the table

read-in because table items are stored in a position which is a function of the key value. (6) *The Pointer Trace Technique*—As no new look-up concepts are involved, this is essentially an indirect version of other techniques. R.W.H.

N65-30162# Auerbach Corp., Philadelphia, Pa.
AN APPROACH TO COMPUTER INSTALLATION PERFORMANCE EFFECTIVENESS EVALUATION Technical Report, Dec. 1964–Apr. 1965
N. Statland, R. Proctor, J. Zelnick, R. Getis, J. Anderson et al
Bedford, Mass., AFSC, Electron. Systems Div. Jun. 1965 *its* Rept.-1243-TR-2
(Contract AF 19(628)-5035)
(ESD-TR-65-276; AD-617613)

The process for computer installation performance effectiveness evaluation operates on a set of specifications and characteristics regarding the principal problem tasks of an installation, its computer complex, and administrative and financial performance. Specifications and characteristics are collected via questionnaires in four categories: computer hardware, extended machine (hardware/software interaction), software evaluation and problem specification. Computer problems can be classified by the environments in which they function, the sources from which data are received and its implied sequence, and the response time within which the computer system is to react. Algorithms are used to summarize the raw data elements and a computer program will select data elements, make simple arithmetic combinations of these elements into composites, and prepare the data for entry into a statistical analysis. Stepwise multiple regression analysis is utilized to determine the relative significance of various data elements and to calculate their relative weights. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-29151# Naval Civil Engineering Lab., Port Hueneme, Calif.
AN EXPERIMENTAL 10,000 VOLT PULSE GENERATOR
S. J. Wooten 19 Apr. 1965 16 p
(TN-702; AD-615564)

Transient voltages, varying from about 100 volts to over 10,000 volts occur on electrical power lines supplying sensitive Naval cryptographic and computer equipment. These transients are capable of destroying, interrupting, or introducing errors into, such equipment. To evaluate the attenuation characteristics of suppression devices and networks to combat these transients, it was necessary to develop a suitable transient generator. This report describes a 0- to 10,000-volt pulse generator developed at NCEL for this purpose, and the method of its employment in a test procedure. Testing by this method has been shown to be simple, reliable, and inexpensive; accurate in pulse amplitude and pulse width; and relatively free of circuit ringing. The pulse generator discharges approximately 4 microfarads of capacitance at 0 to 10,000 volts, with a resulting maximum energy of 200 joules. Author

N65-29190*# Microwave Physics Corp., Garland, Tex.
A MINIMUM-NOISE, LOW TEMPERATURE COOLED PARAMETRIC AMPLIFIER SYSTEM WITH A SIMULATED CLOSED-CYCLE REFRIGERATOR SYSTEM Monthly Report No. 10, 1 Apr.–1 May 1965
[1965] 6 p
(Contract NAS5-9046)
(NASA-CR-63949) CFSTI: HC $1.00/MF $0.50 CSCL 09C

Development continued on an advanced state-of-the-art minimum noise, low temperature, cooled parametric amplifier capable of operating at 4.2° K in a simulated closed cycle (liquid helium, open dewar) cooling system. Work consisted of diode evaluation, parametric amplifier testing, and fabrication of piece parts for the control panel, pump assembly, cold load, and paramp monitor. R.N.A.

N65-29199# Microwave Associates, Inc., Burlington, Mass.
HIGH POWER BEAM-PLASMA AMPLIFIER Final Report, 15 Dec. 1962–15 Mar. 1965
M. A. Allen, C. S. Biechler, P. Chorney, and H. S. Maddix
10 May 1962 196 p refs
(Contract DA-36-039-AMC-0076(E); Proj. Defender)
(Rept.-9; AD-466575)

The research leading to the development of a beam-plasma amplifier delivering 22.5 kw of peak RF power at S-band is described. The characteristics of the final amplifier are presented showing small signal gains of over 55 db and saturated efficiencies of 35.5%. Research into methods of producing highly ionized plasmas for use in amplifiers is presented. Three methods are discussed in detail: (1) the hot cathode Penning discharge; (2) a thermally ionized cesium plasma; and (3) use of β-eucryptite as a lithium ion source. A small signal analysis of the beam-plasma interaction including the effects of finite geometry is presented. A large signal theory using the disc model of the electron beam is described and results showing high gains and high efficiencies are reported. Author

N65-29210# Princeton Univ., N. J. Plasma Physics Lab.
A HIGH VOLTAGE RADIO FREQUENCY VARIABLE CAPACITOR USING A LIQUID DIELECTRIC
Allan Deitz Jul. 1965 28 p refs
(Contract AT(30-1)-1238)
(MATT-341)

This paper describes the theory and construction of a compact high voltage, high current, radio frequency capacitor having a Q in excess of 2000. Four capacitors are utilized in a matching network for a 6 MW 25 Mc pulse rf generator where they are subjected to voltages of 100 kV and currents of 1 kA. The capacitors utilize a liquid dielectric and have operated for 1000 hours. Author

N65-29222*# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.
PHASE NOISE INSTRUMENTATION Final Report
K. W. Smith 7 Dec. 1964 20 p
(Contracts NAS7-100; JPL-950144)
(NASA-CR-63943) CFSTI: HC $1.00/MF $0.50 CSCL 05E

Work was continued in phase noise instrumentation. Experiments with frequency division are outlined. Methods of accomplishing frequency division are outlined, and results from experimentation with division using bistable multivibrators and a phase locked loop indicate that division by bistable multivibrators is the preferable method because of its simplicity and economy. Its outputs are compatible with the use of a digital phase detector. The sine wave outputs from the phase locked loop method require a squaring amplifier. Radio frequency test console instrumentation such as balanced modulators, IF amplifiers, phase shifters, limiters, binary dividers,

phase detectors, and isolation amplifiers are also discussed. Circuit and blocks diagrams for the various instruments considered are included. L.S.

N65-29364# Joint Publications Research Service, Washington, D. C.
THE 21st ALL-UNION SCIENTIFIC SESSION IN HONOR OF THE 70th YEAR SINCE THE INVENTION OF RADIO BY A. S. POPOV
15 Jul. 1965 17 p refs Transl. into ENGLISH of 4 articles from the collection "XXI Vsesoyuznaya Nauchnaya Sessiya, Posvyashchennaya 70-letiyu Izobriteniya Radio A. S. Popovym" Moscow, A. S. Popov Sci.-Tech. Soc. for Radio Eng. and Telecommun., 1965 p 3–15
(JPRS-31092; TT-65-31590)

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1. THE LIMITING RADIATION-PULSE WIDTH OF AN OPTICAL GENERATOR A. L. Mikaelyan and Yu. G. Turkov p 1–3 refs (See N65-29365 18-09)
2. OPTICAL GENERATORS WITH PASSIVE GATES A. L. Mikaelyan, V. Ya. Anton'yants, V. A. Dolgiy, and Yu. G. Turkov p 4–6 ref (See N65-29366 18-09)
3. SELECTION OF OSCILLATION TYPES IN A SEMICONCENTRIC RESONATOR A. V. Korovitsyn, L. V. Naumova, and Z. T. Lebedinskaya p 7 (See N65-29367 18-09)
4. DIFFRACTION WIDTH DETERMINATION OF THE DIRECTIVITY DIAGRAM OF A GAS OPTICAL OSCILLATION GENERATOR V. V. Aller and K. I. Kushtanin p 8–14 refs (See N65-29368 18-09)

N65-29365 Joint Publications Research Service, Washington, D. C.
THE LIMITING RADIATION-PULSE WIDTH OF AN OPTICAL GENERATOR
A. L. Mikaelyan and Yu. G. Turkov *In its* 21st All-Union Sci. Session in Honor of the 70th Yr. Since the Invention of Radio by A. S. Popov 15 Jul. 1965 p 1–3 refs (See N65-29364 18-09) CFSTI: $1.00

Many investigators of optical generators with controlled Q-factors have shown a lack of correlation between the computed and experimental values of radiation pulse-widths. The output pulse of such generators has a long sloping section with a large radiation peak Δ t long following it. The experimental values of Δ t are in the order of 10^{-8} seconds and exceed at least several times the computed values. This work shows that this discrepancy is related to the properties of a filled optical resonator. N.E.A.

N65-29366 Joint Publications Research Service, Washington, D. C.
OPTICAL GENERATORS WITH PASSIVE GATES
A. L. Mikaelyan, V. Ya. Anton'yants, V. A. Dolgiy, and Yu. G. Turkov *In its* 21st All-Union Sci. Session in Honor of the 70th Yr. Since the Invention of Radio by A. S. Popov 15 Jul. 1965 p 4–6 ref (See N65-29364 18-09) CFSTI: $1.00

Among various methods for controlling the Q-factor of an optical resonator, of special interest is a method using passive elements, the transparency of which varies by the effect of light radiation. The insertion into the resonator of a passive cell which has resonance losses causes an increase in the threshold pumping level as a result of which, at the instant of the start of generation, there is a considerable accumulation of active atoms at the metastable level. When the generation begins the laser radiation passing through the cell reduces drastically its losses and the stored energy radiates in the form of a powerful pulse. At the present time, liquid solutions of crypto- and phtalocyanine and various types of glass are used as materials for passive gates. For the investigation of the power characteristics of such a generator, a system consisting of parallel-plane resonator with a length L with and active element (ruby) and a passive cell located inside the mirror is considered. N.E.A.

N65-29367 Joint Publications Research Service, Washington, D. C.
SELECTION OF OSCILLATION TYPES IN A SEMICONCENTRIC RESONATOR
A. V. Korovitsyn, L. V. Naumova, and Z. T. Lebedinskaya *In its* 21st All-Union Sci. Session in Honor of the 70th Yr. Since the Invention of Radio by A. S. Popov 15 Jul. 1965 p 7 (See N65-29364 18-09) CFSTI: $1.00

In gas optical generator resonators it is possible to excite a great number of oscillations. In a number of cases it is necessary that the optical generator produce oscillations of only one type. For this purpose it is necessary to take special measures in order to suppress the undesired types of oscillations and there is made a so-called oscillation type selection. The possibility of type selection in a resonator formed by plane and spherical mirrors is considered. The output power and the spectral composition of the radiation of a gas-optical generator with relation to the length of a plane-spherical resonator were investigated. The results of this investigation are given. Results are also presented for a computation of the diffraction losses of planospherical resonators. N.E.A.

N65-29368 Joint Publications Research Service, Washington, D. C.
DIFFRACTION WIDTH DETERMINATION OF THE DIRECTIVITY DIAGRAM OF A GAS OPTICAL OSCILLATION GENERATOR
V. V. Aller and K. I. Kushtanin *In its* 21st All-Union Sci. Session in Honor of the 70th Yr. Since the Invention of Radio by A. S. Popov 15 Jul. 1965 p 8–14 refs (See N65-29364 18-09) CFSTI: $1.00

The width of the directivity diagram of a gas OKG (Optical Oscillation Generator) depends on the quantity of transverse types of oscillations, the wave front of each type and the optical properties of the mirrors through which the radiation emerges from the resonator. In a particular case when one type of transverse oscillation is excited in the OKG and the wave front has a spherical shape which can be obtained, for example, in a semiconcentric resonator the length of which is about the same as the mirror radius, it is possible by common optical methods to transform the spherical wave coming out of the resonator into a plane wave with the width of the directivity diagram determined only by the diffraction. For this purpose it is necessary to have the center of the emerging spherical wave coincide with the focal plane of the optical system located after the resonator. Consideration is given to several arrangements which provide plane waves in a semiconcentric resonator. N.E.A.

N65-29369# Telefonaktiebolaget L. M. Ericsson, Stockholm (Sweden).
ERICSSON TECHNICS, VOLUME 21, NO. 1
S. Eklund, ed. 1965 188 p refs

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1. ON THE DYNAMIC BEHAVIOUR OF ELECTROMAGNETIC RELAYS: A THEORETICAL AND PRACTICAL STUDY C. Ahlberg p 3–110 refs (See N65-29370 18-09)
2. STUDY OF CERTAIN TYPES OF CYCLIC GRADINGS FOR RANDOM HUNTING J. G. Valenzuela p 111–184 refs (See N65-29371 18-09)

N65-29370 Telefonaktiebolaget L. M. Ericsson, Stockholm (Sweden).

ON THE DYNAMIC BEHAVIOUR OF ELECTROMAGNETIC RELAYS: A THEORETICAL AND PRACTICAL STUDY

Curt Ahlberg *In its* Ericsson Tech., Vol. 21, No. 1 1965 p 3–110 refs (See N65-29369 18-09)

After an introductory survey of earlier theories the author presents some novel ideas which permit a simple mathematical analysis of the operate and release motion of the relay armature. The armature travel is divided into sections, the end points of which are determined by the changes of load during the motion. Conversion of mechanical coordinates, force and travel, into "magnetic coordinates", flux and permeance, allows simple formulae to be deduced for armature speed, acceleration and time of passage through a section. The new theory opens up entirely new prospects for the study of the dynamic performance. The armature acts, for instance, as its own speed controller under conditions which are analysed.

N65-29371 Telefonaktiebolaget L. M. Ericsson, Stockholm (Sweden).

STUDY OF CERTAIN TYPES OF CYCLIC GRADINGS FOR RANDOM HUNTING

José Gerstl Valenzuela *In its* Ericsson Tech., Vol. 21, No. 1 1965 p 111–184 refs (See N65-29369 18-09)

An approximate method for calculation of the time congestion and the distribution of the number of occupied available devices in gradings with random hunting and the interconnection number two is presented. The method assumes that the grading is constituted of two parts, one called partial grading which consists of all outlets available from one inlet group, the other being the remainder of the grading. Solutions for the partial gradings are given and, in order to take into account the influence of the remainder of the grading on the part studied, fictitious traffics are introduced. Author

N65-29465*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

CURRENT DISTRIBUTION IN A THIN FILM SUPERCONDUCTING STRIP TRANSMISSION LINE

A. R. Sass and I. D. Skurnick (RCA) [1964] 27 p refs

(NASA-TM-X-51975) CFSTI: HC $2.00/MF $0.50 CSCL 09C

In the long wavelength limit the current distribution in a thin film superconducting strip transmission line can be described by an inhomogeneous Fredholm equation of the second kind. By considering a fluxoid conservation derivation of this equation, physical insight into the structure of the kernel follows naturally. An approximate analytic solution to the integral equation is derived for a specified range of geometrical parameters commonly encountered in practice. The solution is obtained by making use of the Liouville-Neumann method of successive iterations and approximating the resulting series by a series involving powers of a defined coupling factor. It is shown that the critical current of the thin film superconducting strip transmission line, based on the calculations in the paper and a critical current density hypothesis, is underestimated by less than 5%. Author

N65-29477*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.

THE CYLINDRICAL ANTENNA WITH NON-REFLECTING RESISTIVE LOADING

Tai Tsun Wu and Ronold W. P. King [1964] 15 p refs

(Grant NsG-579)

(NASA-CR-58438) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The distribution of current along a center-driven cylindrical antenna is obtained when the materal forming the antenna is resistive. The particular case is considered when the impedance per unit length of the antenna is a function of the distance from the end. A solution is obtained specifically when the current is represented by an outward traveling wave with no reflected wave. The admittance of the antenna and the far field pattern is determined. Field patterns are evaluated for a wide range of lengths. These are characterized by a single major lobe with a very small minor lobe structure. Author

N65-29520# Radio Corp. of America, Camden, N. J. Communications Systems Div.

PRODUCTION ENGINEERING MEASURE: MICROELEMENT CRYSTALS, MICROMODULE PROGRAM EXTENSION II Formal Engineering Report

Nov. 1964 109 p

(Contract DA-36-039-SC-75968)

(AD-610191)

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1. PRODUCTION ENGINEERING MEASURE: GLASS ENCLOSED MICROELEMENT CRYSTAL UNITS 11 p (See N65-29521 18-09)
2. PRODUCTION ENGINEERING MEASURE: CRYSTAL MICROELEMENTS 20 p (See N65-29522 18-09)
3. PRODUCTION ENGINEERING MEASURE: CRYSTAL MICROELEMENTS 66 p (See N65-29523 18-09)

N65-29521 McCoy Electronics Co., Mount Holly Springs, Pa.

PRODUCTION ENGINEERING MEASURE: GLASS ENCLOSED MICROELEMENT CRYSTAL UNITS Final Report

In RCA Production Eng. Meas.: Microelement Crystals Nov. 1964 11 p (See N65-29520 18-09)

Micromodule crystal element development, through analysis, preproduction, and pilot run phases is described. Specifications required the design of a reliable crystal element which would be compatible with the micromodule packaging concept and have a frequency range from 7.0 to 70.0 Mc. The problem areas discussed involve process methods, handling, fixture design, holder design and material and process determination. W.M.R.

N65-29522 Bulova Watch Co., Woodside, N. Y. Electronics Div.

PRODUCTION ENGINEERING MEASURE: CRYSTAL MICROELEMENTS Final Report

In RCA Production Eng. Meas.: Microelement Crystals Nov. 1964 20 p (See N65-29520 18-09)

Micromodule crystal element development, through analysis, preproduction, and pilot run phases is described. Specifications required the design of a reliable crystal element which would be compatible with the micromodule packaging concept and have a frequency range from 7.0 to 70.0 Mc. The problem areas discussed involve process methods, handling, fixture design, holder design and material and process determination. Fifteen crystal units were fabricated, mounted, sealed, and tested with the new holder. W.M.R.

N65-29523 Midland Mfg. Co., Inc., Kansas City, Kans.

PRODUCTION ENGINEERING MEASURE: CRYSTAL MICROELEMENTS Final Report

In RCA Production Eng. Meas.: Microelement Crystals Nov. 1964 66 p (See N65-29520 18-09)

Micromodule crystal element development, through analysis, preproduction, and pilot run phases, is described. Specifications required the design of a reliable crystal element which would be compatible with the micromodule packaging concept and have a frequency range from 7.0 to 70.0 Mc. The

problem areas discussed involve process methods, handling, fixture design, holder design, and material and process determination. Facilities for manufacturing and testing microelement crystals were established, and 575 crystals were produced and tested. W.M.R.

N65-29612# International Business Machines Corp., Owego, N. Y. FSD Space Guidance Center.
STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS (SCORRE) Final Report, 1 Feb. 1963–28 Feb. 1965
Frank A. Frankovsky [1965] 58 p refs *Its* Rept. No. 8
(Contract DA-36-039-AMC-00161(E))
(IBM-65-521-08; AD-616007)

This report contains the results of a series of experiments conducted between 1 February 1963 and 28 February 1965 on capacitors of the tantalum oxide, ceramic, mica, and glass dielectric types. The experiments were conducted to provide design information that would characterize the radiation response of the capacitor in terms of the dielectric material and device construction. Included also are the results of a study conducted for Picatinny Arsenal of the behavior of a critical timer circuit in which failure modes and thresholds were determined analytically and confirmed experimentally. The studies utilized pulse reactor radiation and a high-energy electron beam. Author

N65-29626# Royal Aircraft Establishment, Farnborough (England).
A LOW FREQUENCY, VOLTAGE-TUNED OSCILLATOR HAVING A VERY SHORT RESPONSE TIME
C. W. Skingle Jun. 1962 18 p refs
(RAE-TN-STRUCT-315)

A voltage-tuned oscillator is described which produces a sinusoidal output of constant amplitude over the frequency range from 5 c/s to 1 Kc/s, the output frequency being linearly dependent on the input control voltage. Instantaneous changes of frequency may be made with no "ringing" of the output. The design is based on standard analogue computing elements, very few other components being required. Author

N65-29642# Royal Aircraft Establishment, Farnborough, (England).
AN INTEGRATING AMPLIFIER FOR INSTRUMENTATION
E. T. de la Perrelle London, Min. of Supply, Sep. 1954 19 p refs
(RAE-TN-INSTN-144)

The note discusses the use and design of amplifiers the output of which resembles, in essential features, the integrand with respect to time of the input. The relations between the gain and phase displacement versus frequency characteristics required to produce the desired result are shown to be a compromise, which is realisable in practice. A feedback integrator, which attenuates at frequencies below the lower limit of integration, is analysed and discussed. Author

N65-29672# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
QUARTZ CRYSTAL AGING EFFECTS Interim Report, 15 Feb. 1963–15 Feb. 1965
R. B. Belser and W. H. Hicklin 15 Feb. 1965 95 p
(Contract DA-36-039-AMC-02251(E))
(IR-8; AD-464866)

Approximately 325 quartz resonators were measured for aging and reliability at 85° C over periods up to 14 months. Of 96 low-frequency resonators only 46% passed the initial aging requirement of <5 ppm during the first 30 days. Ten Mc AT-cut resonators, fabricated for reliability and cement bond evaluation, were examined. Of 27 units 100% reliability was maintained for 11 months, based on an aging rate of $<1 \times 10^{-7}$ per week. Sixteen Mc AT-cut resonators fabricated, aged, and exposed to gamma radiation doses of 10^4 rads exhibited frequency changes of a few parts in 10^7 which was the same order of magnitude of changes incurred by control specimens exposed to the same thermal and mechanical experiences. X-ray diffraction investigations of quartz made concurrently with aging studies revealed strains due to edge grinding, scratches, silver spotting, plating separation, twinning, bonding cements, metal films, internal defects, and twisting due to mounting systems. E.E.B.

N65-29690# National Research Council of Canada, Ottawa (Ontario).
BULLETIN OF THE RADIO AND ELECTRICAL ENGINEERING DIVISION, NATIONAL RESEARCH COUNCIL OF CANADA, VOL. 15, NO. 1, JAN–MAR. 1965
Mar. 1965 73 p

Both the scientific program and the construction of new major instruments and supporting facilities at the Algonquin Radio Observatory have progressed favorably. Erection of the structural components of the 46-meter (150-foot) diameter radiotelescope is well along, as evidenced by the progress photograph presented. At the same time, the manufacture of the various control components, such as the control console, the servo system, the master equatorial unit, and the error detector, has been keeping pace in the shops of the subcontractors. Manufacture and assembly of components for the 10-cm interferometer continue, with an extensive installation program being planned. The polar mounts for the 3-meter paraboloids are now in place, and the housing for the waveguide feed structure is nearly completed. The main function of the building is to provide a fairly stable environment for the waveguide assembly. A new laboratory building is nearing completion which will house equipment used for meter-wavelength observations, chiefly of solar radiation. In addition, special facilities are being provided to mount photometers, cameras, and associated equipment for auroral and air-glow measurements. N.E.A.

N65-29707# Compagnie Generale de Telegraphie Sans fil, Paris (France).
NATURE AND CHARACTERISTICS OF THE PARASITIC OSCILLATIONS IN THE M-TYPE CARCINOTRONS [CHARACTERISTIQUES ET NATURE DES OSCILLATIONS PARASITES DANS LES CARCINOTRONS M]
M. Marechal Washington, Navy Dept., Apr. 1965 20 p refs *Its* Transl. No. 900
(AD-464383)

The characteristics of the parasitics in the M type carcinotrons are specified. Their behavior in terms of various parameters were studied. The nature of the spectrum is defined from the experiment. Various assumptions as to the origin of these parasitic oscillations are offered. Author

N65-29716*# Hughes Research Labs., Malibu, Calif.
ELECTRODE SURFACE PHYSICS RESEARCH
R. G. Wilson 28 Jun. 1965 165 p refs
(Contract NAS3-5249)
(NASA-CR-54182; HRL-5249-S) CFSTI: HC $5.00/MF $1.00
CSCL 09C

An experimental tube design, a vacuum system, and experimental techniques for studying electron and ion emission from cesiated nonrefractory and refractory metals, semiconductors, and insulators are under study. Metallic elements were analyzed by certain criteria to determine their relative

potentials as electrode materials on a device subjected to an arrival flux of cesium atoms, high surface electric fields, moderately high temperatures, and energetic cesium ion bombardment. Experimental measurements of effective vacuum work functions, cesium surface ionization current densities and critical temperatures, cesium ion desorption energies (at low coverage), cesiated electron emission S curves and work functions, the influence of applied surface electric fields, contamination, and time hystereses effects were made for molybdenum, molybdenum silicide, copper, iron, chromium, aluminum oxide, and tantalum boride. R.W.H.

N65-29721*# Sperry Rand Corp., St. Paul, Minn. UNIVAC Div.
STUDY OF MEMORY ELEMENTS HAVING TWO RESISTANCE STATES Final Report, 26 Jun.–17 Dec. 1963
[1963] 87 p refs
(Contract NAS5-3383)
(NASA-CR-64007) CFSTI: HC $3.00/MF $0.75 CSCL 09A

Bistable silver sulfide resistive memory elements are obtained by pressing the pure compound, together with silver and platinum electrodes, into thin pellets. The elements are formed by steady application of voltages in the range of 1 to 10 volts, the time required being less the higher the voltage. Thereafter, pulses of the proper polarity in the range of 2 to 12 volts and 15 milliseconds duration are sufficient for switching between the stable high and the stable low resistance states. For resistance ratios greater than 4, life-times as high as 3×10^5 cycles were obtained in cycling tests; the failure-to-switch rate is about 5%. The elements operate in vacuum, at −196° C, and at elevated temperatures with reduced energies; stored information survives exposure to 125° C, or to electron bombardment. In dynamic switching the element shows a current-voltage hysteresis pattern which may be interpreted in terms of a self-heated thermistor. Comparisons of the characteristics of silver sulfide, antimony trisulfide and nickel oxide, as memory elements, show silver sulfide to be the preferable choice for space applications. Author

N65-29785*# Physical Electronics Lab., Menlo Park, Calif. Physical Research Div.
PROGRAM OF ANALYTICAL AND EXPERIMENTAL STUDY OF POROUS METAL IONIZERS Summary Report
A. Y. Cho, D. F. Hall, and H. Shelton 15 Jul. 1965 163 p refs
(Contract NAS3-5254)
(NASA-CR-54325; TRW-4148-6013-SU-000) CFSTI: HC $5.00/MF $1.00 CSCL 09C

Twenty three different porous tungsten materials were tested to determine their cesium ion emitting characteristics at a j+ up to 25 ma/cm^2. Improved performance with a low neutral fraction and low critical temperature at high j+ was noted as the manufacturers increased the surface pore density by use of small, graded, spherical W powder. Effects on porous W of carbiding, O, Cr, Be, Ta, Ti and Zr were studied. Evaporative lifetimes of Cu, Cr, Be, Ni, Fe, and Ti on W vs. temperature, coverage, and oxygenation are presented. Author

N65-29823*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS Quarterly Progress Report No. 2, Mar. 4–Jun. 4, 1965
A. H. Powell, ed. [1965] 133 p
(Contract NAS3-6467)
(NASA-CR-54447) CFSTI: HC $4.00/MF $1.00 CSCL 09A

This report describes work to develop and design ground prototype AC Circuit Breakers and DC Engine Contactors suitable for, and tested under, expected launch and space requirements. The Breakers will be rated 1000 volts, 600 amperes, 2000 cps, while the DC Contactors will have a rating of 10 000 volts 10 amperes. During this report period, firming of the design for the actuator mechanism, the selecting of interrupter enclosure materials, and determining basic concepts for the interrupter unit was accomplished. A sketch of the overall breaker in accordance with the design concepts at the close of the report period is included. N.E.A.

N65-29898# General Electric Co., King of Prussia, Pa.
ACCELERATED TESTING OF HIGH RELIABILITY PARTS
T. Walsh, H. S. Endicott, G. Best et al Griffiss AFB, N. Y., RADC, May 1965 106 p
(Contract AF 30(602)-3415)
(RADC-TR-65-64)

As a result of reliability testing of glass dielectric capacitors, data has been accumulated which offers an indication of an upper temperature limit for thermal acceleration of failures. The data which is still being gathered shows that an analytical expression for insulation resistance is extremely important in formalizing the stress response of the dielectric. Preliminary analysis of high stress data indicates that the oxide film resistor, the R-2008 P5 diode and the transistors have shown significant trends or failures; however, additional work is being performed in these areas to confirm the failure mechanisms. Author

N65-29921# George Washington Univ., Washington, D. C. Human Resources Research Office.
APPLICATION AND TEST OF THE FORECAST CONCEPT OF ELECTRONICS MAINTENANCE ON NAVY LORAN EQUIPMENT
Edgar L. Shriver and Robert C. Trexler May 1965 50 p refs
(Contract DA-44-188-ARO-2)
(TR-65-3; AD-616753)

This report describes the Technical Advisory Service rendered to the Navy in connection with the Task FORECAST concept of electronics maintenance. This concept is presented as a collection of policies, methods, techniques, and services integrated in a plan for improved level of electonics maintenance in the services. Special reference is made to the application of the FORECAST concept to the Navy LORAN system and to the resulting products and level of performance achieved. In implementing FORECAST procedures, Navy chief petty officers, working with FORECAST scientists, produced a technical manual and training program, using an especially designed device and programed instruction. The same tests in identifying malfunctions in LORAN systems were given to 86 Navy electronics technicians. FORECAST trained, and to 12 graduates of a conventional Navy course. FORECAST students identified 39% of the bad parts; conventionally trained students, 13%. Author

N65-29942# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF A MAGNETRON INJECTION SWITCH TUBE IN CLASS A AMPLIFIER OPERATION
William C. Connor and Herbert L. Dozier, Jr. (M.S. Thesis) 1964 45 p refs

The principle of the magnetron injection gun has been successfully employed by Litton Industries in its Injectron series of high voltage switch tubes. The pentode-like nature of the collector current-collector voltage characteristics of these tubes indicates their possible use in amplifier applications. In this investigation a Litton L-3408 Injectron® switch tube is treated as a conventional triode in class A amplifer

operation. Operating characteristics and tube parameters were determined and the observed operation compared with that predicted by theoretical analysis. Conclusions are drawn concerning the validity of treating the L-3408 as a conventional triode, and recommendations are made concerning areas for further investigation. Author

N65-29943# Naval Postgraduate School, Monterey, Calif.
AN X-BAND FERRITE PHASE SHIFTER
Francis Le Roy Roach (M.S. Thesis) 1964 89 p refs

Research with ferrites has shown that these materials possess a number of nonreciprocal properties when used in the microwave frequency range. This unusual behavior has led to an increased usage of ferrites in microwave devices. Extensive experiments conducted at the National Bureau of Standards, Boulder, Colorado, verified the theory and feasibility of obtaining precision linear phase shift measurements using ferrites as the control media inside X-band waveguide. Results of the experiments showed that the ferrites used for phase shift control at X-band should have the following properties: High mu, low loss tangents, high Curie Temperature, low saturation fields, and high resistivity. Author

N65-29981# Sandia Corp., Albuquerque, N. Mex.
ADVANCE AND PRIME GENERATOR FOR DRIVING DIGITAL MAGNETIC LOGIC
E. J. Bernard and T. A. Howard [1965] 11 p refs Presented at the 1965 Intern. Magnetic Conf., Washington, D. C.
(SCDC-64)-1835)

A temperature stable, self-timed, pulse generator is presented which operates from a low voltage power supply and utilizes the characteristics of a square loop tape wound core in conjunction with a resonant charging circuit to develop the waveforms which are needed to drive digital magnetic logic devices employing multiaperture ferrite cores in a resistance flux transfer scheme. Author

N65-29987# Bureau of Ships, Washington, D. C.
NOISE OF FREQUENCY MODULATION IN A CONTROLLED M TYPE CARCINOTRON
M. Leclerc Feb. 1965 16 p refs Transl. into ENGLISH of the article "Bruit de Modulation de Frequence d'un Carcinotron M Pilote" *Its* Transl. No. 901
(AD-464198)

Measurements taken from a controlled M-type carcinotron indicate its possible use as power tubes to form Hertzian beams and for Doppler radars. It is considered promising for applications requiring a bandwidth and an efficiency higher than those of a klystron; and efficiency, output power, and noise level better than those of a power TPO. The minimum locking power of the M-type carcinotron is close to 100 mW and varies very little with tube frequency. For a given frequency, the locking band was found to be linear up to a controlling power of 15 W; beyond this locking band does not increase. Results of signal-to-noise ratios and measurements of FM noise under Doppler frequencies are presented graphically, and it is established that the signal-to-noise ratio of the carcinotron is 5 dB lower than and varies with the quality of the driver. M.W.R.

N65-29999# Harry Diamond Labs., Washington, D. C.
C-BAND RECIPROCAL PHASE SHIFTERS AND AMPLITUDE MODULATORS
Frank Reggia 30 Mar. 1965 26 p refs
(HDL-TR-1284; AD-615778)

This report describes the design and operation of high-speed amplitude and phase modulators in standard rectangular waveguide systems for the 5- to 7-Gc frequency range. These small reciprocal ferrite modulators are generally characterized by low insertion loss, microsecond response time, matched input impedance for all values of amplitude and phase changes, and power handling capability of a few watts cw and kilowatts peak. Amplitude modulation with positive, negative, or nearly zero phase shift, and phase modulation with small amplitude modulation are also characteristic of these waveguide modulators. Author

N65-30032# Bell Telephone Labs., Inc., N. Y.
MICROWAVE DIODE RESEARCH Tenth Quarterly Progress Report, 10 Sep.–9 Dec. 1964
P. J. Fillingham 20 Mar. 1965 17 p refs
(Contract DA-36-039-SC-89205)
(Rept.-19; AD-615382)

This report describes a low-impedance GaAs tunnel diode wafer that is designed for operation as either an amplifier or oscillator at 10 Gc with enhanced dynamic range. Parasitic resistance and inductance are held to low values by eliminating the etching process, by embedding the wafer in a matrix, and by coating the semiconductor with metal. GaAs diode wafers with peak currents of 10 to 100 ma, speed indices of 10 to 16 ma/pf, and resistive cutoff frequencies of 23 to 30 Gc have been made for testing the performance of low-impedance 10-Gc circuit structures. Author

N65-30042# Varian Associates, Beverly, Mass. Bomac Div.
NOISE SOURCE FOR MILLIMETER WAVELENGTH Final Progress Report, 1 Jul. 1963–1 Oct. 1964
Arnold M. Eklund. [1964] 47 p refs
(Contract DA-36-039-AMC-03229(E))
(Rept.-5; AD-616274)

Development and calibration procedures are given for a prototype hot load noise standard and a gas noise source for use at 4.3 mm and 3.2 mm wavelengths. It was found that the hot load noise standard operating at 1000° C totaled 4.85 dB at the waveguide switch junction of the calibration test set-up. Neon and argon filled noise tubes were investigated with fill pressures varying from 5 to 60 mm of Hg. Calibration of the noise tubes against the hot load standard was accomplished using a single ended mixer at 3.2 mm and a balanced mixer at 4.3 mm. The operating temperature of the neon tubes was very high and increased with life causing failure after 50 hours. Operation of the argon tubes was relatively cool, and the noise output did not change after 350 hours. Mounts were investigated that positioned the noise tube at angles from 0° to 17° with respect to the waveguide; noise output from the 0° mounted tube exceeded that of the 15° mount by almost 2 dB. Excess noise ratio measurements varied between 17.7 and 18.1 dB, when compared to the hot load standard operating at 1000° C. C.T.C.

N65-30043# Philco Corp., Blue Bell, Pa.
WIDEBAND IF ELECTRONICALLY CONTROLLED CONTINUOUSLY VARIABLE TIME DELAY TECHNIQUES Final Report, May 1963–Nov. 1964
M. A. Kraft, A. B. Measor, and R. Middlestead Griffiss AFB, N. Y., RADC, Apr. 1965 145 p refs
(Contract AF 30(602)-3056)
(RADC-TR-65-5; AD-616264)

The all-pass constant resistance lattice network is the classical network for phase correction. A modification to the network, the all-pass half-lattice network has been studied for its variable time delay properties and implemented to obtain time delay variation of 72 nanoseconds in excess of a constant delay. In addition to the all-pass half-lattice network, an all-pass resistance-capacitance section was developed. The advantage of the resistance-capacitance approach is a simpler

control of the time delay. A variable voltage applied to a varactor was the complete control mechanism for the section. A total of 18 sections were cascaded to demonstrate the feasibility of the technique. A time delay variation of 23 nanoseconds was available with a switching time of 5 microseconds to change the delay state. The signal bandwidth obtained exceeded that of the lattice network approach. A bandwidth of 65 Mc, the band extending from 15 Mc to 80 Mc, was achieved.
Author

N65-30073# Naval Postgraduate School, Monterey, Calif.
USE OF MITROVIC'S METHOD IN PREDICTING LIMIT CYCLES IN FEEDBACK CONTROL SYSTEMS WITH ONE AND TWO GAIN VARIABLE NONLINEARITIES
Paul L. Wilson (M.S. Thesis) 1964 295 p

Analysis and design of linear feedback control systems by application of the basic Mitrovic method is well established. However, little has been done in applying the basic Mitrovic method to nonlinear systems. The objective of this work was twofold. First, Mitrovic's method as applied to systems with a single gain-variable nonlinearity predicts limit cycles with results comparable to existing analysis methods. Secondly, an analog computer study was made on a system with two gain-variable nonlinearities and the results interpreted by Mitrovic's method.
Author

N65-30092# Airton, Inc., Morris Plains, N. J.
DUPLEXER FOR SIDE-LOOKING RADAR Second Quarterly Report, 1 Oct.–30 Dec. 1964
Morrell L. King, Donald A. Lepore, J. W. Nielsen, and E. Wantuch 30 Dec. 1964 44 p refs
(Contract DA-28-043-AMC-00280(E))
(R11-471; AD-617568)

A three-cavity limiter was designed and constructed in which the middle resonator is a single crystal YIG sphere. High power tests have shown limiting to occur at 50 watts peak, and continuing to a level of 30 KW. A total of fifteen materials have been evaluated in the three-port circulator. Peak power measurements have been made to a level of 500 KW, one composition exhibits .45 db loss at this level. The phase shift section of the four-port circulator has been tested at 200 KW peak power.
Author

N65-30094# Army Electronics Labs., Fort Monmouth, N. J.
L-BAND AMPLIFIER DESIGN FROM TWO-PORT PARAMETERS
V. Gelnovatch and G. E. Hambleton Apr. 1965 25 p refs
(ECOM-2588; AD-617373)

Transistors now possess the capability to operate in the L-band region. This report describes an amplifier design using y-parameters measured at the design frequency and the fabrication of a laboratory amplifier model. Design calculations and performance data are presented.
Author

N65-30101# Watkins-Johnson Co., Palo Alto, Calif.
STUDY OF DISTORTION IN KLYSTRONS AND TRAVELING-WAVE TUBES Seventh Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965
William Kunz [1965] 29 p
(Contract DA-36-039-AMC-02321(E))
(Rept.-7; AD-617910)

This report describes the work accomplished during the seventh quarter of the study of distortion in klystrons and traveling-wave tubes. Experimental results are given for various versions of the test vehicle, the WJ-237, a PPM focused 2.5 watt L-band traveling-wave tube. Experimental results include the two-tone phase characteristics and the two-tone balanced intermodulation characteristics as a function of frequency and helix voltage. The program plan for the last quarter is listed.
Author

N65-30109# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
HIGH POWER VARACTOR FOR UHF TRANSMISSION Quarterly Progress Report, 1 Jan.–31 Mar. 1965
G. A. Louis [1965] 20 p
(Contract DA-28-043-AMC-00278(E))
(QPR-3; AD-617539)

This report describes the epitaxial layer structure and its evaluation and control. The theory covering the diffusion of impurities during epitaxial growth is discussed. Improved low temperature oxide passivation is described. Comparisons are made between unpackaged and packaged die characteristics. Minor changes in the test circuit are noted.
Author

N65-30124# Hughes Aircraft Co., Fullerton, Calif.
IMPROVED DELAY LINE TECHNIQUES STUDIES Final Report
Lisle M. Sanborn Griffiss AFB, N. Y., RADC May 1965 81 p refs
(Contract AF 30(602)-3474)
(Rept.-64HF-0197/A4264; FR-14-010; RADC-TR-65-45; AD-617693)

Dispersive delay lines have proven to be a very stable and reliable pulse compression technique. As a result of increased requirements placed on pulse compression systems such as bandwidth, and time-bandwidth products, dispersive delay line techniques must be improved constantly to remain compatible with such systems. This effort was for the investigation of improved dispersive delay line technology as applied to pulse compression systems. Higher frequency of operation, broader bandwidth and greater ease of fabrication were the primary areas of interest. Two dispersive delay line configurations were investigated. The first configuration was a technique based on the dispersive characteristic which results from elastic waves propagating in thin metal strips, and the second configuration was based on slow wave propagation in a yttrium iron garnet. An investigation was undertaken to determine a highly efficient transducer to be used in conjunction with the dispersive delay lines. Vacuum deposited cadmium sulfide transducers proved to be most desirable and successful in constructing delay lines of broad instantaneous bandwidth.
Author

N65-30125# General Electric Co., Schenectady, N. Y. Microwave Tube Business Section.
INVESTIGATION OF VARIOUS ACTIVATOR REFRACTORY SUBSTRATE COMBINATIONS Final Report, Feb. 1964–Feb. 1965
John H. Affleck and William T. Boyd Griffiss AFB, N. Y., RADC, Jun. 1965 61 p refs
(Contract AF 30(602)-3395)
(RADC-TR-65-100; AD-617779)

An investigation was conducted to examine the properties of various materials suitable for dispenser cathode systems. Work function, evaporation rate, and poisoning effects have been measured in an effort to characterize these systems. It has been shown that various barium dispenser cathode systems may have effective work functions at 1250° K in the range of 2.40 to 1.80 ev and that excess barium oxide in the matrix gives emission characteristics similar to the oxide cathode. Low mass gases such as oxygen, carbon monoxide and carbon

dioxide have deleterious effects on the barium dispenser systems while the effects of hydrogen and methane seem to depend strongly on the nature of the emitting surfaces as well as other parameters encountered in the normal testing procedure. A diode test in a commercial type of tube demonstrated the feasibility of a simplified fabrication procedure for producing a low work function emitter, $\phi = 1.80$ ev at 1250° K.

Author

N65-30131# Crystalonics, Inc., Cambridge, Mass.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND TO INSURE THE RELIABILITY OF THE C600 SERIES FIELD EFFECT TRANSISTORS Final Report
[1964] 151 p
(Contract DA-36-039-AMC-01483(E))
(AD-617401)

An engineering report is presented on improved manufacturing techniques for a silicon field effect transistor. Processing improvements on diffusion, oxidation, cleaning procedure, dice probing and mounting, bonding, masks and alignment system, packaging, device testing, life test racks, IBM data processing, and reliability verification are discussed. The transistor achieved an objective failure rate of .05% per 1000 hours at 25° C at a 90% confidence level. All test data and information are summarized. R.N.A.

N65-30140# Microwave Associates, Inc., Burlington, Mass.
X-BAND SOLID-STATE DETECTOR/AMPLIFIER Final Report, 1 Jul. 1963–15 Mar. 1965
J. J. Brule [1965] 139 p refs
(Contract DA-36-039-AMC-03274(E))
(AD-617003)

Techniques for the design and development of solid state components and subassemblies for X-band portable radar applications were reviewed and evaluated. The use of forward dc bias for mixer diodes proved to be a feasible method of realizing near optimum mixer performance with local oscillator power levels in the 50 to 100 microwatt range. The possibility of realizing efficient down conversion and oscillation in a self-oscillating tunnel diode mixer was established. Solid state devices to perform the limiting, mixing, local oscillation, and IF preamplification functions of detector amplifier circuits were developed. High power diode limiters requiring no control voltages were developed in waveguide and strip transmission line. Integrated mixer preamplifier assemblies with an overall noise figure of 8.0 db were realized. A small compact solid state source using a snap-off diode as a high order multiplier yielded 10 mw output power. A tunnel diode self-oscillating mixer with integral IF preamplifier assembly was designed. Test models of three solid state detector amplifier circuits were fabricated and tested. R.N.A.

N65-30152# California Univ., Berkeley. Electronics Research Lab.
STUDY OF CROSS-FIELD AMPLIFIERS Sixth Quarterly Progress Report, 15 Oct. 1964–15 Jan. 1965
T. Van Duzer et al 15 Jan. 1965 8 p
(Contract DA-36-039-AMC-02164(E))
(Rept.-6; AD-617324)

By combining a set of noise-figure measurements with linear transformation theory, a method for determining the noise fluctuation in crossed-field guns was developed. This method is being used to study a long Kino gun. The theory developed for studying noise characteristics of forward-wave crossed-field amplifier is being used to analyze several types of noise transducers. Transducers being considered include an abrupt velocity-jump, a gradual velocity jump and periodic velocity jump. The theory developed for studying potential minimum in crossed-field guns was extended to include the sorting effect of the magnetic field as well as the sorting effects of the potential minimum itself. The theoretical analysis of the smooth-bore magnetron was extended and expressions were derived for space-charge density, electric field, anode current density, and circulating current density. Author

N65-30155# Mictron, Inc., Albany, N. Y.
C.W. X-BAND VOLTAGE TUNABLE OSCILLATOR Seventh Quarterly Progress Report, 1 Jan.–31 Mar. 1965
M. R. Boyd and M. Weinstein [1965] 19 p
(Contract DA-36-039-AMC-03270(E))
(Rept.-7; AD-617396)

Attempts to determine the factors which contributed to the wide variation in rf performance in the development of a tunable oscillator are discussed. Changes were made to alleviate the critical spacing between straps, but results from this design change were inconsistent and performance varied for the tubes tested. Speculations were made as to why the tube design is beset with intermittent behavior. These included the fact that the tube is large compared with a wavelength, the field configurations and interactions are more sensitive to aberations, and the large physical size isolates the tube interaction from the external circuit. C.T.C.

N65-30157# Bendix Corp., Davenport, Iowa. Pioneer-Central Div.
DESIGN AND DEVELOPMENT OF FREQUENCY TEMPERATURE COMPENSATED QUARTZ CRYSTAL OSCILLATORS, PHASE I Interim Report, 1 Apr.–31 Dec. 1964
Richard H. Bangert and Donald L. Thoman 9 Apr. 1965 94 p refs
(Contract DA-28-043-AMC-00042(E))
(Rept.-3115A-65; AD-617787)

Quartz crystal oscillator models, operating at a frequency of 3 mc and employing frequency temperature compensation to achieve a deviation of less than ± 0.5 ppm over the temperature range of $-40°$ C to $+65°$ C were designed and fabricated. The required and achieved performance characteristics are tabulated. Extensive testing was performed on the models to evaluate the temperature transient response, load variation, harmonic distortion, maximum power consumption, crystal grouping, compensation network values, and the radio interference. Frequency vs temperature, and frequency error vs time graphs are included. L.S.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-29142*# Westinghouse Electric Corp., Baltimore, Md. Defense and Space Center.
F.M. TRANSMITTER, RF TEST CONSOLE Final Report Appendix H
12 Feb. 1965 55 p ref
(Contracts NAS7-100; JPL-950144)
(NASA-CR-63908) CFSTI: HC $3.00/MF $0.50 CSCL 09

Designed parameters are presented for linear frequency modulation of a locked oscillator. The design for the system is feasible provided that: (1) A voltage-controlled oscillator can be fabricated that exhibits the specified residual frequency modulation and linearity. (2) A phase detector with a linear transfer of output voltage to input phase is used. (3) A count down divider is used in the feedback channel to constrain the phase deviation within the linear limits of the phase detector. (4) The modulation index and the division of the feedback counter are matched such that the linear range of the phase detector is not exceeded. (5) A realizable compensation network whose transfer function is the inverse of the transfer of frequency output to pre-distort the baseband modulation is used. E.E.B.

N65-29144*# Field Emission Corp., McMinnville, Oreg.
INVESTIGATION OF ELECTRON EMISSION CHARACTERISTICS OF LOW WORK FUNCTION SURFACES Quarterly Progress Report No. 2, 28 Dec. 1964–31 Mar. 1965
L. W. Swanson and L. C. Crouser 6 May 1965 47 p refs
(Contract NASw-1082)
(NASA-CR-63911) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Investigation of the total energy distribution of field emitted electrons, performed in the temperature range 77–1059° K, confirms the theoretically predicted inversion temperature and supports the general features of the free-electron model for tungsten. Measurements of the energy exchange accompanying field emission on clean tungsten under more ideal conditions show striking deviations from theory. Although the general qualitative features of the existing theory of "Nottingham" emission heating and cooling were confirmed, certain discrepancies were noted between experiment and theory in regard to the amount of energy exchange per electron and the value of the temperature boundary which separates emission heating and cooling. The discrepancies between the inversion temperatures determined by measurements of the total energy distribution and the Nottingham effect may be due to a preponderance of conduction by holes below the Fermi level. Confirmation of the free-electron model of tungsten by the energy distribution results may be somewhat fortuitous and a two-band electronic structure containing holes and electrons may be more proper for tungsten. Work function vs. cesium coverage results on the (100) and the (110) planes of tungsten suggest a surface polarizability for cesium between 5 and 7 A^3 for the two planes. Author

N65-29567# Control Research Associates, Laurel, Md.
STUDY OF THE DYNAMIC STABILITY AND CONTROL OF LARGE NON-RIGID AEROBALLISTIC VEHICLES, VOLUME I
[1965] 215 p

CONTENTS:

1. MATHEMATICAL THEORY OF THE TIME-OPTICAL CONTROL PROBLEM D. C. Lewis and P. Mendelson p 1–142 (See N65-29568 18-10)

2. SIMULATION AND COMPUTATION K. A. Ivey p 143–190 (See N65-29569 18-10)

N65-29568 Control Research Associates, Laurel, Md.
MATHEMATICAL THEORY OF THE TIME-OPTIMAL CONTROL PROBLEM
Daniel C. Lewis and Pinchas Mendelson *In its* Study of Dyn. Stability and Control of Large Non-Rigid Aeroballistic Vehicles, V. 1 [1965] p 1–142 (See N65-29567 18-10)

An analysis of existing mathematical theory applicable to the solution of time optimal control problems is presented. Included are data on closed form solutions of some switching surfaces; methods for the elimination of parameters; the involutory character of the transformation; the determination of the initial value of ϵ (analog method); analytical methods for the determination of the initial value of ϵ; the switching manifolds for the third order linear control problem with one zero eigenvalue and two non-zero oppositely signed but numerically equal eigenvalues (derivation of manifolds and transition times); a certain generalization of the time-optimal control problem; the geometry of switching surfaces and the topological invariants of switching methods; and proof of general theory. W.M.R.

N65-29569 Control Research Associates, Laurel, Md.
SIMULATION AND COMPUTATION
Keith A. Ivey *In its* Study of Dyn. Stability and Control of Large Non-Rigid Aeroballistic Vehicles, V. 1 [1965] p 143–190 (See N65-29567 18-10)

The simulation and computation of the mathematical theory applicable to the solution of time optimal control problems is presented. A third order system with analog simulation, hand calculated trajectories, digital simulation, third order system 7090 program, determination of initial ϵ value, and dual mode operation is included, together with the fourth order program in Fortran for an IBM 7094 computer. Results of some test runs which have been made using this program are also presented. W.M.R.

N65-29862# Naval Postgraduate School, Monterey, Calif.
A STUDY OF MICROELECTRONIC CIRCUIT PARAMETERS FOR NON-DIGITAL APPLICATIONS
Timothy J. Cronin, Jr. (M.S. Thesis) 1964 63 p refs

Microelectronics is introduced with definitions for some of the more controversial terms encountered in this new field. Thin-film resistive elements are examined from the distributed parameter point of view and impedance functions for use in microcircuit analysis are derived. A source of parasitic capacitance found in silicon integrated transistors is introduced by way of a sample calculation. A small signal analysis for a simple linear amplifier stage is presented using microcircuit concepts along with transistor circuit theory. Author

N65-29871# Harry Diamond Labs., Washington, D. C.
AN EASY WAY TO DETERMINE THE SHAPE OF A DRIVING FUNCTION FROM THE RESPONSE OF A LINEAR SYSTEM
John S. Wicklund 20 Apr. 1965 17 p refs
(ADL-TM-65-19; AD-616126)

A method is described for correcting data to account for the response of the measuring device. It is particularly useful for work with transient signals, and numerical examples of this application are given. Author

N65-29937# Santa Clara Univ., Calif. Electrical Engineering Dept.
TOPOLOGICAL ANALYSIS AND SYNTHESIS OF SINGLE-CONTACT NETWORKS Final Report, Jun. 1964–Jun. 1965
Shu-Park Chan Jul. 1965 83 p refs
(Grant NsF GP-2760)

This investigation was divided into two phases, the analysis and the synthesis of SC networks. In the analysis, the main objective was to consolidate the contributions of the researchers in the application of linear graph theory to the analysis of SC networks. The existing properties of the SC functions were studied under various functional transformations. Thus a set of new properties and new functional transformations

were derived from the old ones. In the second phase of the investigation, a standard procedure was formulated for the realization of a given SC function. Also, a set of realizability conditions were developed from which testing procedures may be generated to determine the realizability of a given function as an SC function. Author

N65-29940# Naval Postgraduate School, Monterey, Calif.
CHROMATIC AND SPHERICAL ABERRATION IN ELECTROSTATIC LENSES
Orelan R. Carden, Jr. and Gordon W. Tinker (M.S. Thesis) 1964 121 p refs

High resolution cathode-ray display devices demand focusing systems that reduce total aberration to the lowest possible value. Magnetic focusing systems have proven superior to electrostatic systems with respect to total aberration, but their size, weight, and power requirements restrict their use. Hence considerable effort is being put into high resolution electrostatic focusing systems. The two limiting aberrations, spherical and chromatic, are analyzed in this thesis for four types of electrostatic lenses and the results compared. Author

N65-29969# Naval Postgraduate School, Monterey, Calif.
ANALYTICAL METHOD FOR ANALYSIS AND DESIGN OF CONTROL SYSTEMS
Liu Shu-hsi (Ph.D. Thesis) 1964 184 p refs

A new method for design of control systems in the time domain is presented. The adjustable parameters, the roots and the zeros of the system are evaluated simultaneously either by hand or by computer. The method is applicable to any system configuration and is able to handle a large number of adjustable parameters. The method is analytical; any degree of accuracy can be obtained. Author

N65-30019# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif. Advanced Research Dept.
TRANSIENT RESPONSE OF THE TEM PRIMARY WAVE IN RADIAL TRANSMISSION LINE
Melvin M. Weiner [1960] 22 p refs Submitted for Publication
(Contract AT(29-1)-1183)
(EGG-1183-64)

Analysis of the time response for the TEM primary wave in radial transmission line with impulse, step, and ramp excitations at the center is extended by means of a Green's function formulation to the more general case of a circular distribution of point sources about the center. Some inverse Laplace transforms are evaluated for modified Bessel functions of the form $K_n(as)I_m(-bs)$. Author

N65-30132# Northeastern Univ., Boston, Mass.
PULSE SHAPING BY MANIPULATING TRANSFORM ZEROS Scientific Report No. 1
J. B. Campbell, S. H. Chang, D. W. Fermental, and N. T. Tsao-Wu 29 Dec. 1964 48 p refs
(Contract AF 19(628)-3312)
(AFCRL-65-20; AD-617403)

The Fourier transform of a pulse, a time-limited function of bounded amplitude, is characterized by an infinite set of zeros in the complex frequency plane. The possibility of a transform zero canceling a system function pole, was used by Gerst and Diamond to design signal inputs to a system to yield pulse outputs for the elimination of intersymbol interference. Gerst and Diamond also pointed to the value of differentiable pulses as design tools. The feasibility of shifting complex zeros to their conjugate positions in the frequency plane, was used by Hofstetter and Walther to find a set of pulses with an identical autocorrelation function. This paper reviews certain transform properties, and explores operations on transform zeros for the purpose of pulse shaping. In particular, zero manipulations for the following purposes are discussed. (1) By removing transform zeros, a pulse is shaped to have more derivatives. The zero removal process is extended to yield an infinitely-differentiable pulse. (2) By zero deletion and shifting, a pulse is made to approximate a chosen waveform. (3) By zero deletion and shifting, a pulse is shaped to have: (a) a specified amplitude density spectrum (e.g., rectangular-pulse-like); or (b) a specified energy density spectrum (e.g., complementary to "colored" noise of the $1/f$ type). Author

N65-30148# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
ACTIVE CONTROL OF BOOSTER ELASTICITY Final Report, Oct. 1963–Aug. 1964
Robert L. Swaim Apr. 1964 79 p refs
(AFFDL-TR-64-189; AD-617314)

The problem of providing an automatic control system for a large booster subject to severe mode interaction (defined as a strong aerodynamic coupling between the rigid-body motion and one or more elastic modes of the vehicle) was investigated. It was shown that the preliminary control system design must include the significant elastic modes when mode interaction is present. The active control philosophy of using auxiliary control inputs to increase the frequencies of the elastic modes sufficient to reduce the mode of interaction in the forward-loop appears to be a false notion. It is the free-free bending modes which interact with the rigid-body motion, and input forces cannot alter their mode shapes and frequencies. They can be altered only by mass and structural stiffness changes to the basic vehicle. Analysis also showed that transient response should not be specified in terms of closed-loop, short-period frequency and damping ratio as a criterion for control system synthesis when the vehicle is subject to severe mode interaction. LS

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-29274# Aberdeen Proving Ground, Md. Ballistic Research Labs.
DESIGN AND CONSTRUCTION OF AN 84-FOOT NON-METALLIC TOWER FOR ANTENNA TESTING
Charles W. Lyle Jan. 1965 16 p ref
(BRL-MR-1631; AD-464277)

This report describes the design of a nonmetallic tower for testing antennas. Means are provided for rotating the test items about various axes in order to simulate the attitudes in flight of missile-carried antennas. Author

N65-29379*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME ADVANCES IN TECHNIQUES FOR FREE-FLIGHT TESTING IN HYPERSONIC WIND TUNNELS

Lionel L. Levy, Jr., and John B. Mc Devitt [1964] 12 p refs Presented at 22nd Semiann. Meeting of the Supersonic Tunnel Assoc., Brussels, 24–25 Sep. 1964
(NASA-TM-X-54707) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The note discusses some of the developments in free-flight techniques being exploited at Ames Research Center to permit (1) measurement of local pressure and heat transfer, and (2) the measurement of aerodynamic characteristics of models under conditions of steady-state ablation. N.E.A.

N65-29384*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SOME COMPARISONS OF AIRCRAFT FLIGHT CHARACTERISTICS WITH THOSE SHOWN BY GROUND SIMULATION
Lawrence A. Clousing [1964] 52 p refs Presented at 4th Congr. of the Intern. Council of the Aeron. Sci., Paris, 24–28 Aug. 1964
(NASA-TM-X-51994) CFSTI: HC $3.00/MF $0.50 CSCL 14B

Past literature on piloted ground research simulator results as compared with flight results is briefly reviewed. The results of three specific types of research simulation investigations, (1) jet transport landings, (2) take-off certification tests, and (3) STOL handling qualities in landing approach, are compared with flight results for the purpose of presenting further information on simulator requirements, in terms of simulation equipment, accuracy of parameters, task criteria, and pilot familiarization required for valid results. It is shown that the important factors in ground simulation are: (1) visual cues and task criteria in jet transport landings, (2) motion cues, visual cues, cockpit sophistication, and exact ground effect parameters in take-off certification studies, and (3) sophisticated motion simulation and control characteristics duplication in STOL landing approach studies. Author

N65-29395*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA DEVELOPMENTS IN COBALT-BASE SUPERALLOYS
John C. Freche, Richard L. Ashbrook, and Gary D. Sandrock 5 Oct. 1964 17 p refs Submitted for Publication
(NASA-TM-X-54737) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Cobalt-base superalloys, in which low-volatility elements are the primary alloying constituents and the use of chromium is minimized, are investigated. A ternary alloy, Co–25W–1Ti, was selected as the basis for systematic alloying studies that initially utilized only low-volatility additives. Subsequent work utilized the addition of small amounts of chromium (up to 3%). All alloys were induction-melted under an argon gas cover. Melts weighed approximately 3 pounds. Stress rupture tests showed that the two strongest chromium-free alloys developed were Co–25W–1Ti–0.4C and Co–25W–1Ti–1Zr–0.4C. The alloys have good ductility and their tensile properties are summarized. The two strongest low-chromium-content alloys developed were Co–25W–1Ti–1Zr–3Cr–0.4C and Co–25W–1Ti–1Zr–3Cr–2Re–0.4C. The as-cast stress rupture properties and tensile properties of these alloys are illustrated. Potential aerospace applications, in which low-chromium alloys might be used, are discussed. M.R.W.

N65-29497*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PERFORMANCE EXPERIENCE WITH THE NEW JPL WIND TUNNEL DATA ACQUISITION SYSTEM
E. A. Laumann and R. F. Covey [1964] 11 p Presented at 22d Demiann. Meeting of the Supersonic Tunnel Assoc., Rhode St. Genese, Belgium, 24–25 Sep. 1964 Submitted for Publication (Contract NAS7-100)
(NASA-CR-58982) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The general characteristics, performance experience, and measured accuracies of a new data acquisition system capable of performing the complete digital data function, from powering transducers to tabulating final test results, for a wind tunnel facility are described. Performance experience has shown the new data acquisition system to be a highly accurate and reliable device. Its flexibility is proving valuable in the number of different types of tests which can be conducted. Its adaptability to various types of test techniques indicates that the system will have a long useful life. R.N.A.

N65-29524*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
MECHANICAL PLAN, RF TEST CONSOLE, APPENDIX J Part of the Final Report
A. C. Frey Nov. 1964 8 p Prepared for JPL (Contracts NAS7-100; JPL-950144)
(NASA-CR-63995) CFSTI: HC $1.00/MF $0.50 CSCL 14B

Described is the proposed mechanical arrangement of the RF (radio frequency) test console, which will be packaged in four 19-inch cabinet racks, located side by side. Modular construction will be used in the self-manufactured chassis such as the transmitter and receivers. The chassis was arranged so that the transmitter is contained in one cabinet, the receivers in a second cabinet, the linear summer in a third cabinet, and the commercial instrumentation in a fourth cabinet. The equipment arrangement is based upon three factors: the electrical interrelationship of the various units, the operating inter-relationship of the units, and the location of the controls and displays with respect to human factors considerations. Included are illustrations of the proposed arrangement and the packaging concept. S.C.W.

N65-29595# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service.
ANALYSIS OF RUNWAY MARKING CONFIGURATIONS FOR BRIGHT DAYLIGHT CONTACT FOG OPERATIONS Interim Report
Robert K. Mc Kelvey and Guy S. Brown Nov. 1964 82 p refs (RD-64-154)

Four experiments were conducted to determine the feasibility of utilizing runway marking to provide guidance for visual transition for landing and for monitoring of runway distance to go. The experiments were done in a visual landing simulator modified to present the field and brightness contrast relationships characteristic of a bright daylight contact fog with a visual range of approximately 1,200 feet. The results suggest that it is feasible to provide visual support under the specified visibility conditions with patterns compatible with the standard narrow gauge touchdown lighting configurations. In addition, it appears possible that these systems can be designed without marking elements in the critical centerline wear area of the landing zone and in "double ended" versions providing distance to go information. Future work will attempt to extend the distance indicating code to a configuration adequate for 12,000 feet, as well as for the 7,000-foot runway used in these experiments. Author

N65-29611# Royal Aircraft Establishment, Farnborough (England).
THE AIR SUPPLY AND EXHAUST SERVICES REQUIRED BY HYPERSONIC WIND TUNNELS AND THE LIMITATIONS THESE IMPOSE ON TUNNEL PERFORMANCE
J. M. Shaw Oct. 1960 24 p refs
(RAE-TN-AERO-2720)

Three types of hypersonic tunnel are considered. They use air as the working fluid and it is proposed that they should run for a few seconds at each operation. The first, a high-density

tunnel in which a normal schlieren system will function; can reach a Mach number of 14. The second, a low density tunnel, can reach a Mach number of 21. The third, a high-enthalpy tunnel, can provide an enthalpy equivalent to 25,000 ft/sec at low Mach number. The stagnation pressures and temperatures are calculated for each tunnel over a range of working section conditions. It is shown that high pressures and temperatures are required in all cases. It is concluded that the electric arc heater should be developed to meet these requirements and it is suggested that one plant might be constructed to supply all three types of tunnel. Author

N65-29644# Royal Aircraft Establishment, Farnborough (England).
FURTHER DEVELOPMENTS IN LOW-SPEED WIND-TUNNEL TECHNIQUES FOR V/STOL AND HIGH-LIFT MODEL TESTING
John Williams and Sidney F. J. Butler London, Min. of Aviation, Jan. 1964 57 p refs
(RAE-TN-AERO-2944)

Experimental methods for wind-tunnel testing of high-lift models with boundary-layer control and circulation control were previously described by the authors about four years ago. Some of the further advances since then, particularly those to expedite investigations on jet and fan lift models at the Royal Aircraft Establishment (Farnborough and Bedford), are discussed in the present paper. Attention is mainly concentrated on the following three selected topics: (a) Special mechanical and strain-gauge balance rigs for jet-blowing models; (b) Engine exit and intake flow simulation at model scale; (c) Ground simulation by a moving-belt rig. The need, development and application of these techniques are considered, together with some problems still to be overcome. Author

N65-29645 Rocky Flats Div., Dow Chemical Co., Golden, Colo.
AN APPARATUS FOR THE PREPARATION OF STANDARD GAS MIXTURES CONTAINING TRACE LEVEL COMPONENTS
E. D. Ruby Oak Ridge, Tenn., AEC. [1964] 7 p
(Contract AT(29-1)-1106)
(RFP-358)

A gas blending system has been made for use in the preparation of standard gas mixtures. Blends can be made containing minor components at concentration levels down to 10 ppm by volume. These blends are used to calibrate various analytical instruments. Author

N65-29691# Army Missile Command, Huntsville, Ala.
AUTOMATIC CONTROL ASPECTS OF THE AMICON 8000-KW PLASMA FACILITY
L. L. Dickerson, Jr. May 1965 37 p
(RR-TR-65-7; AD-466190)

This is an interim report of progress in applying automatic controls to the programming of arc heater power supply and mass rate of flow of air to the arc heaters of the Army Missile Command 8000-kw plasma facility at Redstone Arsenal, Alabama. The simulated flight altitudes have been limited to not much lower than 300,000 feet. This report presents a plan to permit the next series of flight simulations to extend down to approximately 150,000 feet for certain types of phenomena. Author

N65-29793# United Kingdom Atomic Energy Authority, Capenhurst (England). Production Group.
ORGANISATION AND METHODS USED FOR THE VACUUM-TIGHTNESS OF THE ISOTOPE SEPARATION PLANT AT PIERRELATTE
G. Mongodin, J. Delatosse, H. Deterck, C. Guilbard, and Y. Benet 1965 75 p Transl. into ENGLISH from Le Vide (Brussels), no. 108, Nov.–Dec. 1963 p 528–579
(PG-11(CA)) HMSO: 12s 6d

The problems involved in achieving vacuum tightness in a gaseous diffusion plant for the separation of U^{235} are reviewed, and the importance of efficient control equipment for each component is stressed. Details are given on the construction of such a plant. The methods adopted and the instruments used for detection with helium and ammonia, and by pressure rise are described, and the necessity for considering vacuum tightness in design concepts at each level of plant construction is discussed. The various stages where leak testing is important are tabulated. The quantitative characteristics of detection units are defined, their functional characteristics are analyzed, and helium leak test phases are mathematically described. The study demonstrated the need to know the numerical values of the characteristic constants of the detection units, and the importance of verifying sensitivity standards for each test. C.T.C.

N65-29806*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
MANNED SPACE FLIGHT NETWORK PERFORMANCE ANALYSIS FOR THE SA-8 MISSION
29 Jul. 1965 30 p
(NASA-TM-X-55242; X-552-65-269) CFSTI: HC $2.00/MF $0.50 CSCL 22D

This report covers the orbital portion of the SA-8 mission through the first five revolutions. A brief description of the performance of the MSFN for the SA-8 mission is presented in this report. It is prepared for those who have some familiarity with the network systems. The report concentrates on troubles experienced without emphasis on those systems which performed as expected. The flight plan was to launch a Saturn S-1 stage, an S-IV stage, an R&D pressurized instrument unit, and an Apollo boilerplate spacecraft and Pegasus B payload combination. Following launch, separation, and insertion of the payload, the panels of the satellite were extended and the Pegasus B began its programmed 18-month experiment. This report reviews the network mission preparations, performances of the basic on-station systems, and the computing and ground communications systems. Finally, the mission data accumulation program is summarized. Author

N65-29909# Twin Industries Corp., Sayre, Pa. Special Products Div.
SHELTER ELECTRICAL EQUIPMENT S-318( )/G Final Report, 15 Jun. 1962–30 Sep. 1964
[1964] 83 p
(Contract DA-36-039-SC-90814(E))
(Rept.-13; AD-466120)

The design, planning, material purchase, quality control, and manufacturing of a thinwall, lightweight field and mobile shelter capable of being transported by M-37 truck and by fixed or rotary wing aircraft is presented. The problems that arose in material selection, forming and spot welding of materials, and performance tests are discussed, and test evaluation data are included. Although the initial weight requirement was 300 lb, the final shelter weight was 415 lb, due to weight accumulation of adhesive, sealer and paint applications, and added splices and backup strips for increased strength. Recommendations are included on material selection, welding techniques, bonding methods, and quality assurance procedures. W.M.R.

N65-29910# Naval Ordnance Lab., White Oak, Md.
THE NOL 3 MW 3-PHASE A-C ARC HEATER (MARK II) Final Report

R. E. Lee and R. L. Humphrey Jul. 1965 31 p refs
(Aerodynamics Res. Rept.-210; NOLTR-63-222; AD-465797)

An a-c arc heater developed for the NOL 3 MW research arc is described. This heater has three doughnut-shaped electrodes with internal coils to increase the magnetic field strength. The operation and performance of this design are discussed. Temperatures from 3500 to 4000° K with efficiencies from 15 to 23 percent were obtained at pressures from 10 to 15 atmospheres. Multiple arc streamers and the diffusion of the arc into the center of the chamber were observed. A high level of contamination of the effluent gas, an unsatisfactory magnetic design, and short component life make the design unsatisfactory. Methods of eliminating these problems are discussed. Author

N65-30012# Varian Associates, Palo Alto, Calif.
A HIGH CURRENT INVESTIGATION OF A 10 MeV S-BAND ELECTRON LINEAR ACCELERATOR Final Report
J. Haimson and N. Pering Jun. 1964 62 p refs *Its* Eng. Rept.-312-1F
(Contract DA-49-146-XZ-200)
(DASA-1523; AD-615915)

This investigation reports on a series of experiments performed with a high current source attached to an existing 10-Mev electron linear accelerator operated under steady-state and stored energy conditions. Design and construction details of the source are depicted and the electron beam characteristics are discussed. Achievement of very heavy beam loading of the accelerator waveguide under steady-state conditions without observable pulse shortening effects is discussed together with the demonstration of short pulses of high current when operating in the stored energy regime. A conclusion encourages the development of more advanced injection systems capable of providing shorter pulse lengths and higher currents so that microwave storage systems may be more fully exploited. Author

N65-30071# Office of Aerospace Research, Washington, D. C.
RESEARCH OBJECTIVES 65. PHYSICAL SCIENCES, ENGINEERING SCIENCES, ENVIRONMENTAL SCIENCES, AND LIFE SCIENCES
Jun. 1965 67 p
(OAR-65-3; AD-616987)

It is the purpose of this publication to further stimulate researchers in free-world colleges, universities, and nonprofit and industrial organizations to participate in the Air Force research program. By delineating the various facets of the four general areas of research (Physical Sciences, Engineering Sciences, Environmental Sciences, and Life Sciences), and by describing in detail the specific fields where additional research is required, OAR hopes to spark the enthusiasm of outstanding members of the free-world scientific community to play a part in fulfilling paramount Air Force research needs. Author

N65-30074# Republic Aviation Corp., Farmingdale, N. Y.
LONGSHOT I HYPERSONIC FREE-PISTON TUNNEL. PRELIMINARY CALIBRATION RESULTS
A. H. Lange, J. Boison, N. Brown 21 May 1965 56 p refs
(RAC-2806; SMSD-TR-6550)

This report contains the first results of a continuing calibration program of the Republic Aviation Corporation Longshot I Hypersonic Free-Piston Tunnel. Pitot pressure profiles were measured at three axial locations in the 24-inch (exit diameter) free-jet for nominal Mach numbers of 18, 23, and 29. Instantaneous axial distributions of Pitot pressure also were determined for a nominal Mach number of 23. Free-stream Reynolds number varied from about 0.4×10^6 to 1.5×10^6 per foot. Nominal reservoir temperature and pressure conditions were 2500° K and 2700 atm, respectively. Nitrogen was used as the working fluid. The expanded flow was considered to have reached thermodynamic equilibrium conditions. Data are presented on axial and radial Mach number gradients. Boundary layer thicknesses are determined and compared with theory. Timewise variations of the measured variables are also discussed. Measured stagnation point heat transfer rate was used as a check against semi-empirical techniques for determining reservoir conditions. Author

N65-30076# Royal Aircraft Establishment, Bedford (England).
A DESCRIPTION OF THE R.A.E. HIGH SUPERSONIC SPEED TUNNEL
J. Poole London, Min. of Aviation, Jun. 1960 24 p refs
(RAE-TN-AERO-2678)

An account is given of the High Supersonic Speed Tunnel now nearing completion. The design philosophy is reviewed, the principal features are described and some of the more interesting development problems are noted. Author

N65-30147# Dayton Univ., Ohio. Research Inst.
A SCRUBBER FUME DISPOSAL SYSTEM FOR ARC-PLASMA-JET TESTING Interim Progress Report
John Bodner, Joseph DePalma, and Roger Keith Sep. 1964 31 p refs
(Contract AF 33(616)-7838)
(UDRI-TR-64-111; AD-617889)

A design of a fume scrubber using readily-available components is described, which is useful in channeling and disposing of toxic or nuisance gases arising in the course of flame testing. A cool exhaust is produced, and is under pressure to permit forced venting to the exterior. No moving mechanical parts are employed and corrosion-resistance to permit use of a wide variety of media is easily achieved. An unforeseen benefit is the reduction in noise level resulting from the use of the device, and the scrubber has been found to be of value as an acoustic muffler even in cases where exhaust heat and toxicity are not a problem. Operating characteristics with a variety of media are given. Construction notes are presented for a proposed afterscrubber for gases and various neutralizing tanks for liquids which could be placed in series with the present device if still greater scrubbing effect is desired. Author

N65-30151# Air Force Cambridge Research Labs., Bedford, Mass.
VACUUM ULTRAVIOLET LIGHT SOURCES: NEW EXCITATION UNIT FOR THE RARE GAS CONTINUA Instrumentation Papers No. 85
R. E. Huffman, J. C. Larrabee, and Derek Chambers Jun. 1965 21 p refs Prepared in part by Brower Labs., Inc., Westboro, Mass.
(Contract AF 19(628)-2380)
(AFCRL-65-381; AD-617250)

This report presents experimental details of an excitation unit developed for use in producing the rare gas continua in helium, argon, krypton, and xenon. The unit is essentially a thyratron-controlled modulator which replaces the spark-gap external trigger in a conventional spectroscopic "condensed discharge". With this unit, it is possible to obtain the Hopfield helium continuum in the 580 to 1100Å wavelength region with improved intensity and stability so that an improved bandwidth of slightly less than 0.25Å is obtained with a 2.2 m normal-incidence vacuum monochromator and photoelectric scanning detection. This excitation unit is described, and its application to study of the rare gas continua and to absorption cross-section measurements in hydrogen is illustrated. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-29164# Aerospace Corp., San Bernardino, Calif.
LAMINAR BOUNDARY LAYER–INVISCID FLOW INTERACTIONS IN SHOCK TUBES
Victor D. Blankenship and Paul M. Chung Apr. 1965 42 p refs
(Contract AF 04(695)-469)
(TDR-469(S5810-12)-4; BSD-TR-65-299; AD-465917)

The inviscid flow variations caused by the boundary layer in low pressure shock tubes are analyzed by solving the inviscid flow-boundary layer interaction problem associated with shock tube flows. The analysis is necessary for the accurate prediction of the shock tube test times. Previous theories have predicted test times which are in considerable disagreement with experimental results for low shock Mach numbers. The interaction problem is solved here by postulating particular series forms of solution for the inviscid region and boundary layer respectively. The boundary layer equations are perturbed to third order and each equation is solved numerically. In order to preserve the universality of each of the perturbed boundary layer equations, the perturbation parameter is described by an integral equation which is also solved in series form. Results may be obtained for any given shock tube conditions by forming the three series to a consistent order of magnitude. An approximate equation is then developed which extends the theory beyond its region of convergence. The present results show improved agreement with experimental data over the results of previous theories. Author

N65-29176# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MEASUREMENT TECHNIQUES IN TWO-PHASE FLOW
G. A. Wikhammer, E. O. Moeck, and I. P. L. MacDonald Oct. 1964 33 p Presented at the Conf. on Res. for and in Ind., Carleton Univ., Ottawa, 2–3 Sep. 1964
(APPE-24; AECL-2215) Available from Atomic Energy of Canada, Ltd. Chalk River: $1.00

The application of two measurement techniques to the study of two-phase gas/liquid flow phenomena is described. The first technique relies on an imbedded thermocouple to detect the incipient critical heat flux as well as the surface temperature of an electrically heated rod, forced-circulation cooled by a steam/water mixture at 1000 psia. The heater-thermocouple assembly is calibrated in situ. The overall temperature difference between the thermocouple plane in the heater wall and the bulk coolant is measured when cooling by water and then superheated steam. The Colburn relationship is used to obtain the film temperature drop. By difference, the effective wall thermal resistance is obtained. In the second technique, small electrodes imbedded in an insulating wall are utilized to measure the thickness of a thin, conducting water film on the surfaces of a complex flow channel. Air/water mixtures at room temperature and pressure below 100 psia are circulated through the test channel. An electronic network produces 2 microsecond voltage pulses, proportional to the film thickness, and suitable for spectrum analysis. A pulse-stretch-and-hold unit shapes the pulses such that high speed paper recorders, coincidence counters, analog tape units, and other correlators can be utilized. Author

N65-29195# California Univ., Berkeley. Inst. of Engineering Research.
AN EXPERIMENTAL STUDY OF THE ROTATIONAL DISTRIBUTION FUNCTION OF NITROGEN IN A SHOCK WAVE
F. Robben and L. Talbot May 1965 59 p refs
(Contract Nonr-222(45); Grant AF-AFOSR-538-65)
(AS-65-6; AD-466306)

The electron beam fluorescence technique has been used to measure the rotational energy distribution through shock waves in nitrogen. At Mach 1.7 the deviation from thermodynamic equilibrium was found to be small, and the rotational temperature profile followed the density profile. Comparison with theoretical calculations yielded the rotational relaxation collision number $Z_R = 5$, in reasonable agreement with other determinations. At high Mach numbers the measured rotational distribution function within the shock wave could not be represented by a single temperature, but was found to be representable approximately by the merging of two rotational distribution functions corresponding to temperatures upstream and downstream of the shock wave. The profile of the average local "temperature" defined by the ratio of the total measured rotational energy to the gas density, was found to precede the density profile through the shock wave by an amount which increased with Mach number. Author

N65-29200# Oceanics, Inc., Plainview, N. Y.
EXPERIMENTAL MODEL STUDIES OF THE DYNAMIC VELOCITY FLUCTUATIONS EXISTING IN THE AIR WAKE OF AN AIRCRAFT CARRIER. PART II: APPENDIX (GRAPHS OF EXPERIMENTAL DATA)
August F. Lehman and Paul Kaplan Mar. 1965 63 p
(Contract Nonr-4186(00))
(Rept.-65-21, Pt. II, AD-614673)

Pitch transfer function amplitudes and phases are plotted for horizontal and vertical velocities. Horizontal and vertical power spectra are also given. C.T.C.

N65-29211# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INVESTIGATION OF THE FLOW AROUND PLANE AND AXISYMMETRIC BODIES WITH A DETACHED SHOCK BY A LOW SUPERSONIC VELOCITY STREAM
S. M. Gilinskii and M. G. Lebedev [1965] 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk Mekhan. (Moscow), no. 1, 1965 p 17–23

The investigation of supersonic perfect gas flow around bodies of different shape is continued. The G.F. Telenin method for the integration of the gasdynamics equations is used to analyze the low supersonic-velocity flow around plane and axisymmetric bodies. Mainly the $M_\infty \leq 2$ range is considered. Various cases of the mutual disposition of the limiting characteristics and the sonic line are examined. It is shown how the formulation of the problem of flow with detached shock must be modified for various cases. Results of computations and an estimate of the accuracy of the numerical solution are presented. The obtained results are discussed and compared with the results of other numerical methods and experiment. N.E.A.

N65-29238# Lockheed Missiles and Space Co., Sunnyvale, Calif.
HYPERSONIC INVISCID RADIATING GAS FLOW AROUND A CONE
G. A. Kolton [1965] 9 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 7, 1965 p 118–126

The problem of hypersonic inviscid radiating gas flow around a cone is solved by using the boundary layer method.

In the limiting case of the flow, a nonlinear integral equation is obtained for determining the enthalpy and a method is indicated for its solution. It was concluded that the radiation of a heated gas in the area between the shock and cone surface exerts a primary effect on the temperature, heat content, and density of the gas. The shockwave is curved and the direction of its convexity at the leading edge depends on the relationship between the surface temperature of the cone and the gas temperature at the nose of the cone. R.N.A.

N65-29270# California Univ., Berkeley. Inst. of Engineering Research.
MEASUREMENT OF SHOCK WAVE THICKNESS BY THE ELECTRON BEAM FLUORESCENCE METHOD
F. Robben and L. Talbot May 1965 36 p refs
(Contract Nonr-222(45); Grant AF-AFOSR-538-65)
(AS-65-4; AD-466304)

Shock wave thicknesses and density ratios have been measured in helium, argon and nitrogen by means of the electron beam fluorescence method, over the range $1.5 < M < 17.4$, in a low density wind tunnel. The shock thicknesses in argon and helium agreed well with Mott–Smith theory at the higher Mach numbers, and were between Navier–Stokes and Mott–Smith theory at the lowest Mach number. In nitrogen, the measured shock thicknesses were considerably greater than the predictions of Navier–Stokes theory. Measured density ratios across the shock wave were in good agreement with theory, in the lower density flows. Poorer agreement was found at higher flow densities, leading to estimates of upper bounds for the range of linear variation of fluorescence intensity with gas density. Measured density ratios for shocks produced in divergent free-jet flows were found to be in better agreement with theory after a viscous curvature correction was applied. Author

N65-29271# California Univ., Berkeley. Inst. of Engineering Research.
SOME MEASUREMENTS OF ROTATIONAL TEMPERATURES IN A LOW DENSITY WIND TUNNEL USING ELECTRON BEAM FLUORESCENCE
F. Robben and L. Talbot May 1965 30 p refs
(Contract Nonr-222(45); Grant AF-AFOSR-538-65)
(AS-65-5; AD-466305)

The fluorescence of a 30 kV electron beam has been used as a probe to measure the rotational distribution function of flowing nitrogen in a low density wind tunnel. The fluorescence consists predominantly of the so-called first negative system of nitrogen, a series of bands originating from the $B^2\Sigma^+$ state of N_2^+. Measurements of the intensities of the rotational structure of the (0-0) vibrational band have been used to calculate, through a theoretical model, the original rotational distribution function of N_2 before excitation. This technique was originally proposed by E. P. Muntz, who also carried out a series of measurements was performed in the undisturbed flows of a subsonic nozzle, a Mach 4 nozzle, and free jet expansions from sonic orifices at Mach numbers ranging up to 19. The rotational temperature measurements are shown to be about 3% high at 280° K, with a progressively increasing error at lower temperatures. These measurements also indicated no measurable lag in rotational temperature in the free jet expansions. Author

N65-29273# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
FLOW STUDIES IN A CONTOURED NOZZLE DESIGNED FOR A SMALL HELIUM HYPERSONIC WIND TUNNEL
F. F. Mark Apr. 1965 47 p refs
(Contract NOw-62-0604-c)
(TG-677; AD-466354)

Pressure measurements were made in a contoured nozzle designed for a 2 inch Helium Hypersonic Wind Tunnel. This nozzle was designed to give a uniform Mach 18 flow at the test section. The investigation showed that the measured exit centerline Mach number was less than the design value and that a nonuniform flow existed in this region. These results were attributed to the boundary layer displacement thickness being considerably larger than estimated. Uniform Mach 14.7 flow was produced at a station about one-third of the nozzle length from the exit. The flow characteristics of this nozzle provide a basis for the evaluation of the techniques of estimating the viscous flow correction in small contoured nozzle. Author

N65-29378*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THEORETICAL AND EXPERIMENTAL ASPECTS OF THE SHOCK STRUCTURE PROBLEM
Hans W. Liepmann, Roddam Narasimha (Indian Inst. of Sci.), and Moustafa Chahine [1965] 19 p refs Submitted for Publication
(Contract NAS7-100; Grant NsG-40-60)
(NASA-CR-58878) CFSTI: HC $1.00/MF $0.50 CSCL 20D

Results obtained from an exact numerical solution of the Bhatnagar–Gross–Krook (B-G-K) model, discussions of the Navier–Stokes and Mott–Smith theories, and recent experimental work are presented. The main conclusions reached are the following: (1) The B-G-K model is capable of describing the essential features of the shock layer and leads to reasonably accurate numerical values for the measurable variables. (2) A comparison of the Chapman–Enskog (C-E) approximation applied to the model and the exact solution shows that useful convergence of the C-E series requires stress to pressure ratio less than 0.2, corresponding to shock Mach numbers of less than about 2. (3) The distribution function within the layer is bimodal and exhibits the gradual change from the molecular-beamlike behavior ahead of the shock, to a Maxwellian distribution behind it. The effect of the fast molecule is noticeable many mean free paths behind the shock. (4) The flow appears locally adiabatic, i.e., the total enthalpy is constant to within a few percent. N.E.A.

N65-29397*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT ADVANCES CONCERNING THE TRANSPORT PROPERTIES OF DILUTE GASES
Richard S. Brokaw [1964] 26 p refs Submitted for Publication
(NASA-TM-X-54772) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Some theoretical and experimental developments of the last decade are discussed with emphasis on techniques that can be used to calculate viscosity, thermal conductivity, and diffusion coefficients assuming appropriate interatomic or intermolecular force laws. Three main topics are considered: First, intermolecular potential energy functions for which collision integrals are now available; second, heat conduction in chemically reacting gases; and finally, a closely related topic, the heat conductivity of polyatomic gases. Author

N65-29408*# Chicago Univ., Ill. Dept. of Geophysical Sciences.
ATMOSPHERIC GRAVITY WAVES: A NEW TOY FOR THE WAVE THEORIST
C. O. Hines Oct. 1964 25 p refs
(Grant NsG-467)
(NASA-CR-59259) CFSTI: HC $1.00/MF $0.50 CSCL 08N

This article surveys briefly some features of atmospheric gravity waves, with the objective of bringing their characteristics and their problems to the attention of wave theorists from other disciplines. The inherent anisotropy of their propagation, and further anisotropies and reflection processes that arise in

practice, find analogues in ionospheric and other plasma propagation. They provide a novel field for the application of old techniques, and they pose challenging problems that will give birth to new techniques. Author

N65-29423*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLUTIONS OF EULER'S EQUATIONS ILLUSTRATING EFFECTS OF FINITE EDDIES
Stephen Childress [1962] 70 p refs Submitted for Publication
(NASA-CR-58799) CFSTI: HC $3.00/MF $0.75 CSCL 20D

The two problems treated in this report are intended to illustrate mathematical problems occurring in the solution of Euler's equations for stationary, two-dimensional flows containing one or more closed, finite regions where the vorticity is finite and non-zero (eddies). An approximate procedure derived formally by expansion for slender eddies is used to simplify the analysis, which then reduces to the solution of a non-linear, singular integral equation. Solutions of this equation corresponding to (1) a class of wake bubbles reducing to Riabouchinsky's solution when the vorticity in the eddy is zero, and (2) a class of cusped eddies attached to the base of a slender wedge immersed in a uniform flow, are derived. In the Case (1) it is found that the non-linear interaction between the eddy and the exterior, irrotational flow can result in the branching of solutions at critical parameter values, and consequently that in general the bubble is not uniquely determined by the parameters. Author

N65-29593# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany). Institut für Angewandte Gasdynamik.
INTERACTION EFFECTS OF LATERAL CONTROL JETS EXPANDING INTO A SUPERSONIC FLOW. EXPERIMENTAL AND ANALYTICAL INVESTIGATION WITH SLOT-NOZZLES OF FINITE LENGTH [INTERFERENZWIRKUNGEN SEITLICH AUSTRETENDER GASFORMIGER STEUERSTRAHLEN BEI UBERSCHALLANSTROMUNG. EXPERIMENTELLE UND ANALYTISCHE UNTERSUCHUNGEN BEI VERWENDUNG VON SCHLITZDUSEN ENDLICHER LANGE]
F. Maurer Jan. 1965 86 p refs In GERMAN; ENGLISH summary
(DVL-382; DLR-FB-65-04) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: 21.70 DM

Experimental and analytical investigations are presented in this paper concerning flowfields resulting from a gaseous control jet expanding laterally from slot-nozzles of finite length into a supersonic main flow. The experimental work is restricted to the expansion of cold air into a wind tunnel flow over a flat plate. The experimental results include pressure distributions, normal force coefficients, schlieren- and surface-oilflow pictures. These results provide a basis for developing a flow model for an analytical approximation. The calculated results, when compared with the measurements, show the influence of the different parameters and help to better understand the flow interaction processes. Author

N65-29603# Royal Aircraft Establishment, Farnborough (England).
THE EXPERIMENTAL INVESTIGATION OF THE PROPAGATION OF FAN AND CONJUGATE PLANE JETS IN A TRANSVERSE FLOW [EKSPERIMENTAL'NOE ISSLEDOVANIE RASPROSTRANENIYA VEERNYKH I PARNYKH PLOSKIKH STRUI V POPERECHNOM POTOKE]
E. V. Rzhevskii and V. A. Kosterin London, Min. of Aviation, Apr. 1965 23 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekh. (Kazan), no. 2, 1964 p 68–80
(RAE-LIB-TRANS-1103)

An experimental study has been made of the propagation of a jet from a body into a subsonic transverse stream. Two types of jet were studied, a "fan jet" which issues radially around the circumference of a cylinder with its axis in the flow direction and a "conjugate plane jet" which issues from both surfaces of a flat plate. The results are relevant to conditions in gas turbine combustion chambers. Results are presented for the trajectories and penetration of the issuing jets in both bounded and unbounded transverse streams. It is shown that these trajectories do not depend on the shape of the jet orifice or the jet temperature, but only on the parameter which is a function of the density and velocity of the external stream and the jet. Empirical equations are obtained for calculating the trajectory and penetration of fan and conjugate plane jets. Author

N65-29607# Royal Aircraft Establishment, Farnborough (England).
A NEW METHOD FOR CALCULATING THE SUPERSONIC FLOW PAST A BODY
F. Walkden and J. M. Howie London, Min. of Aviation, Aug. 1962 88 p refs
(RAE-TN-MATHS-89)

A new method is proposed for calculating the supersonic flow of an inviscid gas past a body. The method is applied to the problem of calculating the flow past a two dimensional or axisymmetric body; it is also indicated how the method could be used to calculate three dimensional flow fields. The basic idea of the method is to introduce a transformation from the physical coordinates to non-orthogonal coordinates, consisting of streamlines and outgoing characteristics. The governing equations are solved numerically by finite difference techniques over a rectangular mesh of points in the transformed coordinates. Results are given for a test calculation of the supersonic flow past a cone at zero incidence. Author

N65-29610# Royal Aircraft Establishment, Farnborough (England).
A THEORETICAL EXPLORATION OF THE FLOW ABOUT AN ELECTRIC ARC TRANSVERSE TO AN AIRSTREAM USING POTENTIAL FLOW METHODS
E. G. Broadbent Mar. 1965 40 p refs
(RAE-TR-65056)

The arc cross section is supposed to be a region in which heat is supplied to a continuous stream and in which a body force acts. Pressure variations are assumed small so that incompressible potential flow methods can be used to calculate streamlines and thence flow velocities of the compressible gas by a simple transformation. Example calculations are made in which a non-potential slit is used to obtain a positive drag coefficient, and flow diagrams are given. Author

N65-29625# Royal Aircraft Establishment, Farnborough (England).
A "PSEUDO-VISCOUS" METHOD FOR THE CALCULATION OF TWO-DIMENSIONAL SUPERSONIC FLOW FIELDS
F. Walkden and J. E. Sellars Jan. 1965 38 p refs
(RAE-TR-65009)

An implicit difference scheme is proposed for the numerical solution of the equations governing the two-dimensional supersonic motion of an inviscid gas. It uses streamlines as one of the independent variables which simplifies the

treatment of the conditions at a wall and avoids the errors due to interpolating the shape of the wall. The method relies on "pseudo-viscosity" or "smoothing across the stream-lines" in order to calculate shock-waves in flow fields involving compressions. When compared with the two-dimensional flow past a wedge or with flows involving expansions (where the method of characteristic applies) the present method gives satisfactory results. Author

N65-29637# Royal Aircraft Establishment, Farnborough, (England).
AQUAPLANING
J. C. Cooke Mar. 1965 30 p refs
(RAE-TR-65058)

The phenomenon of aquaplaning of vehicles on wet surfaces is discussed. An account of what happens when it is occurring is given and confirmed by some simplified calculations. An empirical formula (due to Horne) for the speed at which aquaplaning begins is explained by means of Gray's theory of the impact of tyre rubber on the runway and this is tested by further calculations. Possible means of alleviating the effect are discussed and a new one which will require testing is suggested. Author

N65-29675*# Mississippi State Univ., State College. Engineering and Industrial Research Station.
RESEARCH STUDY FOR DETERMINATION OF LIQUID SURFACE PROFILE IN A CRYOGENIC TANK DURING GAS INJECTION Annual Report, 18 Jun. 1964–17 Jun. 1965
E. H. Bishop and W. D. Mc Cain, Jr. 17 Jun. 1965 121 p refs
(Contract NAS8-11334)
(NASA-CR-64055) CFSTI: HC $4.00/MF $1.00 CSCL 20D

An equation for the free liquid surface profile caused by injection of gas bubbles into a tank of liquid was developed. A comparison of calculations using a potential flow model and the Chao model showed that certain undesirable features of the potential flow model were eliminated or reduced by the Chao model. Hence, the potential flow model was dropped from further consideration. Limited progress was made in the area of bubble-to-bubble interference. A direct superposition method was used to obtain a first approximation to the velocity field generated by two bubbles of equal size, rising side by side at the same velocity. Results are presented in graphical form. The surface disturbance caused by a single column of noninterfering bubbles was photographically recorded. Sequence photographs taken from the frames of high-speed motion picture film were made which show the build-up and collapse of the surface disturbance. The origin of the spray droplets which appear above the liquid surface was discovered. These droplets are formed when the gas bubbles break at the free liquid surface. A sequence showing this phenomenon is given. E.E.B.

N65-29704# AVCO-Everett Research Lab., Everett, Mass.
HYPERSONIC BOUNDARY LAYER SEPARATION AND THE BASE FLOW PROBLEM
Robert F. Weiss and Sheldon Weinbaum Jul. 1965 61 p refs
(Contracts AF 04(694)-690; DA-01-021-AMC-12005(Z); Proj. Defender)
(AVCO-Everett-Res. Rept.-221; BSD-TR-65-305; AD-467101)

A detailed analytical investigation of the expansion and separation of a hypersonic boundary layer at the shoulder of a blunt-based body is presented. The expansion is assumed to be inviscid, and numerical results are obtained with a rotational characteristics calculation. A streamline at constant (base) pressure provides the required boundary condition downstream of the shoulder. It is found that both this streamline and the nearby "dividing streamline" are highly curved, concave outward, causing the rear stagnation point to be located quite close to the base. It is shown that the formation of a "lip shock" is the result of the interaction of reflected waves and the constant pressure boundary. As the Mach number increases, this shock moves outward and can intersect and strengthen the bow shock. At high Mach numbers, the expansion-separation process dominates the entire base flow, producing a nonparallel vortical region which extends into the far wake. With the base pressure given by a simple model of the complete base flow, it is possible to calculate the vortical "outer" flow in detail. Finally, an approximate solution of the viscous free shear is derived. The temperature distribution behind a wedge is calculated and compared to experimental data. Author

N65-29734*# National Aeronautics and Space Administration, Washington, D. C.
DIFFUSION IN THE LIQUID–VAPOR CRITICAL REGION [DIFFUZIYA V KRITICHESKOY OBLASTI ZHIDKOST'-PAR]
L. A. Rott Jul. 1965 8 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 3, 1964 p 78–81
(NASA-TT-F-9489) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The equation of isothermal convective molecular diffusion in a binary gaseous mixture is investigated in the liquid–vapor critical region. This phenomenon is accompanied by convective motion of the mixture. As in the critical layerwise separation of a binary liquid system, isothermal diffusion is instigated by the chemical potential gradient of one of the components. The investigated equation can be reduced to the ordinary Fick diffusion equation. It is necessary also to define a function to be interpreted as the diffusion coefficient in the critical region. The diffusion coefficient is shown to have both positive and negative values. Author

N65-29943*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EXPERIMENTAL INVESTIGATION OF A TURBULENT BOUNDARY LAYER AT MACH 6, HIGH REYNOLDS NUMBERS, AND ZERO HEAT TRANSFER
Jerry B. Adcock, John B. Peterson, Jr., and Donald I. Mc Rae Washington, NASA, Jul. 1964 refs
(NASA-TN-D-2907) CFSTI: HC $3.00/MF $0.50 CSCL 20D

An experimental investigation of the turbulent boundary layer on a hollow cylinder was made at a Mach number of 6 and with adiabatic wall temperature at Reynolds numbers based on the distance from the leading edge from 5×10^6 to 33×10^6. Data obtained include turbulent recovery factors, a total temperature profile, velocity profiles, and average skin-friction coefficients by the momentum method. The turbulent recovery factor was found to be approximately 0.88; a slight decrease of recovery factor with increase in Reynolds number was obtained. The velocity profiles, when compared with power profiles, were found to have an increasing exponent with increasing Reynolds number. The measured temperatures in the boundary layer were compared with two theoretical temperature distributions, the Crocco laminar distributions used by Van Driest (NACA TN 2597), a quadratic distribution used by Donaldson (NACA RM L52H04), and with the assumption of a constant total temperature through the boundary layer. The assumption of a constant total temperature was found to give the most accurate value of momentum thickness. The skin-friction results were compared with the theories of Van Driest, Wilson and Van Driest, Cope and Monaghan, with the Sommer and Short T' method, and also with other experimental data Author

N65-29858# Boeing Scientific Research Labs., Seattle, Wash.
A TECHNIQUE FOR STUDYING THE SHOCK-ON-SHOCK PROBLEM Flight Sciences Lab. Report No. 99
E. A. Brown, Jr. and G. J. Mullaney Jun. 1965 18 p refs
(DI-82-0445)

A new technique for studying the interaction of a blast wave with a supersonic projectile is described. A conventional shock tube was combined with a ballistic range by installing a smooth bore powder gun in the dump chamber and firing .300 caliber cone-cylinder projectiles toward the driver. The velocity of the projectile, fired into air at 100 mm Hg, was measured near the muzzle and a computer used to provide a proportional time delay before the shock wave was started down the tube. The projectile and the shock wave, each traveling at about 4000 feet per second, met in a 3-inch diameter window. Two spark light sources were used for shadow photography of the interaction. Typical interaction photographs are shown. Author

N65-29875# Lockheed Missiles and Space Co., Sunnyvale, Calif.
NONSTATIONARY GAS EXPANSION IN A VACUUM FOR VARIOUS LAWS AND DURATIONS OF THE ENERGY LIBERATION
A. S. Fonarev 7 Jul. 1964 13 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 5, no. 1, 1965 p 16–28

The dissipation of a plane layer of an ideal gas of prescribed mass in a vacuum is described by the nonstationary one-dimensional gas dynamics equations. It was shown if the gas-parameter distribution is not self-similar but arbitrary at the initial instant, then, as had been proposed in the numerical solution of the system, self-similar mass-distributions of the parameters are built up in the gas as time passes, where the build-up occurs rapidly. It was noted that the maximum velocity of the X boundary of gas dissipation in the isentropic case of plane dissipation is determined by the magnitude of the sound velocity at the wall at the initial instant for arbitrary initial gas distributions under the condition of no shockwaves in the dissipation process. W.M.R.

N65-29881# Lockheed Missiles and Space Co., Sunnyvale, Calif.
NONLINEAR THEORY OF THE ORIGIN OF TURBULENCE IN FLOWS WITH MEAN VELOCITY GRADIENT
E. M. Khazen [1965] 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 161, no. 4, 1965 p 795–798

The development of pulsations with a finite initial amplitude in the flow of a viscous incompressible fluid is shown. A nonlinear equation for the pulsating velocity is derived using the Fourier transform, and solutions are reached by linear approximations. A basis for the derivation of the estimates is given. The nonlinear mechanism of maintaining undamped turbulence for the pulsating velocity is shown on the basis of a constant gradient, and also on the basis of the differential equations for the spectral tensors of turbulent pulsations. The time-change in energy is graphed for two waves of different amplitude. C.T.C.

N65-29894# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
INTRODUCTION TO THE STUDY OF AERONOMIC COLLISIONS Scientific Report No. 233
Peter Banks 1 Feb. 1965 168 p refs
(Contract AF 19(628)-4014; Grant NsF GP-2914)
(AFCRL-65-191; AD-615970)

In this report a general survey is made of aeronomic collision processes. Particular attention is given to the derivation of energy transfer equations in terms of a suitable collision frequency for energy transfer. It is found that for collisions of electrons with neutral gas particles the most important parameter is the cross section for momentum transfer. Values of this quantity have been obtained for the atmospheric gases and are plotted as a function of electron temperature. An investigation of charge transfer processes has also been made and the cross sections for resonant, accidentally resonant, and non-resonant charge exchange reactions calculated. Throughout all derivations the attempt has been made to indicate the detailed effects of non thermal equilibrium between electrons, ions, and the neutral gases. Author

N65-29939# Aeronautical Research Council (Gt. Brit.)
THE CHANGE OF PITOT PRESSURE ACROSS OBLIQUE SHOCK WAVES IN A PERFECT GAS
W. J. Graham and B. M. Davis London, HMSO, Dec. 1965 4 p ref Supersedes NPL-AERO-1025, ARC-25429; See X65-16345 (ARC-CP-783; NPL-AERO-1025; ARC-25429) HMSO: 1s 6d

The pitot pressure behind an oblique shock wave in a perfect gas has been calculated and compared with the pitot pressure ahead of the shock. Results, for air ($\gamma = 7/5$), are presented graphically for all shock angles and various Mach numbers from 1.0 to ∞. Author

N65-29960*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
STABILITY OF TWO-FLUID WHEEL FLOWS
Eli Reshotko (Case Inst. of Tech.) and Carl F. Monin Washington, NASA, Aug. 1965 27 p refs
(NASA-TN-D-2696) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The stability of an incompressible two-fluid wheel flow to infinitesimal helical disturbances is considered for the case where the inner fluid is heavy and the outer fluid is light. This situation may be viewed as a Rayleigh–Taylor problem in the frame of the rotating fluid and is dynamically unstable. As the density ratio of inner to outer fluid increases, the calculated growth rates increase and approach a limiting value as the density ratio becomes infinite. Growth rates also increase with increasing axial as well as azimuthal wave number. Furthermore, the presence of a fixed boundary outside the light fluid tends to have negligible influence on the growth rates as the density ratio becomes very large. Author

N65-29972# RAND Corp., Santa Monica, Calif.
HYPERSONIC VISCOUS INTERACTION ON A SLENDER BODY OF REVOLUTION WITH SURFACE MASS TRANSFER
Ting Y. Li and Joseph F. Gross Apr. 1965 49 p refs Presented at the Ann. Meeting of the Ger. Soc. of Aerodynamics and Astronautics, Berlin, 14–18 Sep. 1964
(P-2977-1; AD-615944)

The purpose of the paper is to present an analytical formulation of the problem of hypersonic viscous interaction on a very slender body of revolution having a thick boundary layer and with surface mass transfer. Particular attention is directed to establishing the mathematical restrictions necessary for the existence of similar solutions of the laminar boundary layer equations for this class of problems. TAB

N65-29984# Boeing Scientific Research Labs., Seattle, Wash.
FULLY DEVELOPED TURBULENT SUPERSONIC FLOW IN RECTANGULAR CHANNELS Flight Sciences Laboratory Report No. 98
J. Kenneth Richmond and Raymond Goldstein May 1965 49 p refs
(DI-82-0441)

In order to assess properly the gas dynamic aspects of MHD channel flow it is necessary to obtain details of the flow conditions before fields are applied. In a channel with an entrance cross section of one cm square, with lengths up to 20 cm, at a Mach number of about 1.5 and at static pressures approaching one atm, a turbulent boundary layer fills the channel, and fully developed pipe flow turbulence prevails. A simple one-dimensioal theory is presented for this case, relating stagnation pressure change to area change, heat transfer and friction factor. Experiments are described in which a supersonic flow of heated or cold argon was passed into the channel, and the flow rate and temperature varied to cover a range of Reynolds numbers (based on channel width) from 5,000 to 500,000. Total pressure and total temperature changes are correlated with the theory to indicate the progress of boundary layer development and the parameters affecting the friction and heat transfer coefficients. Author

N65-29985# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF THE PREROTATION CHARACTERISTICS OF A FLUID IN THE INTAKE DUCT OF A CENTRIFUGAL PUMP
Wayne R. Osgood (M.S. Thesis) 1964 80 p refs

The direction of flow along the centerline of several sections of the inlet duct of a centrifugal pump was determined using a hot wire anemometer. In contrast to other tests of this kind, the pump was operated with air to facilitate the measurements. The present investigation is part of a program at the U.S. Naval Postgraduate School to evaluate the performance of liquid pumps with air in order to apply aerodynamic measuring methods and equipment to the task. Data were taken with the pump operating at different points on the characteristic curve. The flow direction data are presented as a function of position in the intake duct for various operating conditions. Prerotation was observed, the character of which was in agreement with theoretical predictions in that prerotation was in the same direction as the impeller rotation at the low flow rates and in the opposite direction at the high flow rates. Backflow near the periphery of the duct was observed at the low flow rates. Author

N65-29989# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSATING COMBUSTION OF GAS BEHIND A SHOCK WAVE IN SUPERSONIC FLOW
R. I. Soloukhin 13 May 1965 7 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 5, 1961 p 57–60
(FTD-TT-65-32/1+2; AD-615985)

In the experiments described a shock tube was used to obtain a stream of mixture, in which the temperature behind the front of direct densification jump at the surface of the decelerating body is sufficient for adiabatic spontaneous combustion of the gas. The condition of periodic ignition of the gas behind the disconnected shock wave was investigated. TAB

N65-30009# Northwestern Univ., Evanston, Ill.
LAMINAR AXIALLY SYMMETRIC COMPRESSIBLE JET WITH AN ARBITRARY PRANDTL NUMBER Interim Report, 1 Dec. 1963–1 Jun. 1964
David C. Smith and Ali Bulent Cambell Wright-Patterson AFB, Ohio, ARL Apr. 1965 39 p refs
(Contract AF 33(615)-1160)
(ARL-65-67; AD-615109)

The laminar, compressible, axially symmetric jet problem is solved analytically for a variable viscosity and an arbitrary Prandtl number. The flow is assumed subsonic where compressibility is due to heating only. The viscosity is assumed to be directly proportional to temperature to the one-half. This viscosity-temperature relationship is found to be in good agreement with existing theoretical calculations. An approximation is required to obtain the analytical solution and an *a posteriori* check shows that it introduces a negligible error. The applicability of the solution to arc heated argon plasma jets is discussed. The assumptions required to solve the problem are very accurate up to a temperature of 7500° K for argon at atmospheric pressure. The solution should give a good indication of the enthalpy profiles at higher temperatures. Author

N65-30039# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF PRESSURE PULSATIONS IN A GAS FLOW OF CONVECTIVE HEAT EXCHANGE
S. I. Kosterin, I. A. Kozhinov, and A. I. Leont'yev 5 Apr. 1965 17 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 3, 1959 p 66–72
(FTD-TT-64-1065/1+2; AD-615428)

Results of theoretical and experimental investigation of convective heat exchange in the presence of longitudinal pressure pulsation in a gas flow are described. Author

N65-30105# Huyck Research Center, Stamford, Conn.
ANALYSIS OF THRUST AND FLOW AUGMENTATION OF A COANDA NOZZLE
E. L. Victory Wright-Patterson AFB, ARL, May 1965 59 p
(Contract AF 33(657)-11697)
(HRC-021-2; ARL-65-86; AD-617621)

In order to evaluate the performance of a Coanda Nozzle and to determine its thrust and pumping capabilities, a series of tests were conducted on a Coanda Nozzle designed by Dr. Henri Coanda. The experiments were extended beyond the scope of similar tests carried out on the nozzle at the Training Center for Experimental Aerodynamics. The results showed that the nozzle was capable of creating thrust augmentation of about 1.25, and thus confirmed the conclusions reached by T.C.E.A. Furthermore, it was also shown that the Coanda Nozzle, through the creation of a low pressure zone along the Coanda surface, was capable of augmenting the momentum of the primary by a factor of approximately 1.7. Author

N65-30118# Princeton Univ., N. J.
MASS INJECTION IN A HYPERSONIC CAVITY FLOW
Kenneth M. Nicoll Wright-Patterson AFB, Ohio, ARL, May 1965 75 p refs
(Contract AF 33(615)-1079)
(ARL-65-90; AD-617891)

The present report describes an experimental investigation of a hypersonic cavity flow with mass-injection into the separated-flow region. The experiments were carried out in a helium wind-tunnel at a free-stream Mach number of eleven. The injected gas was helium. Two parameters were varied during the study–the mass injection rate and the height of the separation shoulder relative to the reattachment shoulder. The effects of these parameters on the distributions of pressure and heat transfer rate were investigated. Author

N65-30127# Harry Diamond Labs., Washington, D. C.
FLUID AMPLIFICATION. 14: PARAMETERS AFFECTING THE NOISE IN NO-MOVING-PARTS FLUID DEVICES
Richard N. Gottron and Sanford D. Weinger 15 Apr. 1965 88 p refs
(HDL-TR-1283; AD-618057)

The noise in fluid amplifiers is discussed. Previous work on free circular jets has been applied to confined two-dimensional jets to predict possible noise sources. Possible noise reduction techniques are considered, both in the interaction area of fluid amplifiers and in the design of receivers. Recommendations for future work and an extensive reference list are included. Author

N65-30129# Georgia Inst. of Tech., Atlanta.
THE EFFECT OF A RESONANT ACOUSTIC FIELD ON LAMINAR FLOW IN A CIRCULAR TUBE Interim Report
Kenneth R. Purdy, Thomas W. Jackson, Donald A. Willoughby, H. Grady Keith, and Charles E. Willbanks Wright-Patterson AFB, Ohio, ARL, May 1965 123 p refs
(Contract AF 33(616)-8396)
(ARL-65-96; AD-618100)

The effect of a resonant acoustic field on laminar internal flow was investigated analytically and experimentally. The analytical study was concerned with compressible flow in a circular tube. A recent experimental investigation showed that the density variation of a gas (air) in a resonant acoustic field is essentially the same as that which is predicted by first order acoustics. Therefore, the influence of sound was introduced into the governing equations by: (i) assuming that the density variation of a gas is the same as that predicted by first order acoustics and (ii) assuming that the compression-rarefaction process is isentropic. The experimental investigation was also concerned with circular tube flow. This study utilized tobacco smoke as a tracer in atmospheric air and an axial beam of light to visualize the flow field in the circular tube. With this system the existence of standing vortices was verified and the thickness of the larger vortices was shown to be solely (at least to the accuracy of the measurements that were made) a function of the parameter M/M_o^2. Finally, the experimental heat transfer data were qualitatively explained in the region of flow where the average through-flow velocity was less than the maximum amplitude of the time-dependent z-component of velocity. Author

N65-30167# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
GENERALIZED RAYLEIGH'S PROBLEM IN VISCOUS FLOWS
J. C. Wu and T. Yao-Tsu Wu (Calif. Inst. of Tech.) Mar. 1964 68 p refs
(SM-45868)

The generalized Rayleigh's problem is concerned with the flow due to an infinite cylinder of arbitrary shape moving parallel to its generators through a viscous incompressible fluid. After the general problem is formulated, several methods of solution are discussed. The particular method by separation of variables in terms of various similarity forms is further explored, and some simple solutions are obtained for several cases of special profiles. The method of Green's function is applied to obtain the solution of an infinite flat plate with different parts moving at different velocities. Next, the flow inside an arbitrary infinite wedge is investigated anew with an approach which is somewhat simpler than the previous attempts. The asymptotic behavior of the velocity field and skin friction is examined for small and large values of the time. In particular, Howarth's problem for a semi-infinite plate is solved by using the Green's function, yielding the solution in an integral representation which is useful in computation for all values of the time describing the motion. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-29156# Columbia Univ., Palisades, N. Y. Lamont Geological Obs.
THE PRESSURE DERIVATIVES OF THE SOUND VELOCITIES OF POLYCRYSTALLINE MAGNESIA
Orson L. Anderson and Edward Schreiber [1964] 29 p refs
(Contract AF 49(638)-1355)
(AD-615623)

A polycrystalline sample of MgO was obtained of gem quality. The sound velocities and the pressure derivatives of the sound velocities were measured by the "phase comparison" technique. The pressure derivatives found from experiments up to 4 kilobars are 4.351×10^{-3} km/sec/kbar and 7.711×10^{-3} km/sec/kbar. Arguments are presented which indicate that these pressure derivatives hold up to at least 100 kilobars. These values yield a vanishingly small value of the pressure derivative of Poisson's ratio. The Gruneisen constants of the shear and longitudinal modes are calculated, from which the acoustic Gruneisen constant is estimated to be 1.60. This agrees very well with the Gruneisen constant obtained from thermal properties. Author

N65-29163# Navy Electronics Lab., San Diego, Calif.
GEOACOUSTIC MODELS OF THE SEA FLOOR. I: SHALLOW BERING SEA. 2: MOHOLE (GUADALUPE SITE)
E. L. Hamilton 19 Apr. 1965 52 p refs
(NEL-1283; AD-466164)

Those characteristics of the sea floor that affect the propagation of acoustic energy in the seas were studied and the information needed for a geoacoustic model of the sea floor was investigated. It was determined that an ideal model of the sea floor in an area of experimental sound propagation should include: (1) a detailed topographic chart based on the electronically determined ship's position; (2) information on sub-bottom layering within the upper tens of feet; and (3) sufficient measurements, from both laboratory and *in situ* studies to establish the vertical and horizontal variations in those properties of sediments having to do with sound propagation. Geoacoustic models of certain shallow-water portions of the Bering Sea and of the site of the 1961 experimental Mohole drilling east of Guadalupe Island, Mexico, are presented. These two models contrast strongly: the Bering Sea area has a shallow-water, high-velocity, hard-sand bottom while the Mohole area has a deep-water, low-velocity, soft-clay bottom. Sediment samples from both areas were tested for sound speed and related properties, and laboratory measurements were corrected to *in situ* values. E.E.B.

N65-29191*# California Inst. of Tech., Pasadena. Seismological Lab.
[EXPERIMENTAL INVESTIGATION OF DEVICES FOR SEISMIC STUDIES OF THE LUNAR SURFACE] Final Report, Oct. 1, 1963–Dec. 31, 1964

31 Dec. 1964 41 p
(Grant NsG-535)
(NASA-CR-63950) CFSTI: HC $2.00/MF $0.50 CSCL 17J

This report is a summary of experimentation conducted in studying the deployment of instrumentation into large arrays by a method applicable to use on the lunar surface. Particular emphasis was placed on its use for extension of an array of geophones or explosive charges to perform a seismic refraction study of lunar layering to depths of approximately 500 feet. N.E.A.

N65-29219# National Bureau of Standards, Boulder, Colo.
DATA REDUCTION FOR STABLE AURORAL RED ARCS OBSERVED AT RAPID CITY, SOUTH DAKOTA
J. E. Cruz, Robert Davies, L. K. Droppleman, E. Marovich, L. R. Megill et al 3 May 1965 57 p refs
(NBS-TN-308) GPO: $0.50

All sky photometric surveys in the 6300 Å [01] radiation obtained during the International Geophysical Year at Rapid City, South Dakota have been reduced. The analysis described and the results for the night of September 16/17, 1958 are printed as isophote maps. These maps clearly show the presence of an arc and can be, therefore, a useful tool for further investigations of the stable auroral red arc. Author

N65-29268# London Univ. (England).
SOME F2 LAYER DIFFUSION PROBLEMS INCLUDING A POSSIBLE EXPLANATION OF THE APPLETON ANOMALY
Scientific Report No. 1
P. C. Kendall, D. W. Windle (Sheffield Univ., England), Sylvia Hargreaves (Natl. Center for Atmospheric Res., Boulder, Colo.), and V. Varnasavang 1 Mar. 1965 62 p refs
(Grant AF-EOAR-64-74)
(AFCRL-65-327; AD-466648)

The effect of large scale neutral air motion in the F2 layer is studied theoretically for special models by numerical methods and by approximate methods. It is suggested that electrodynamic drifts at right angles to the magnetic field lines in the F2 layer may be replaced by equivalent drifts along the field lines. The suggestion is used in conjunction with a straight field line model of the ionosphere to obtain a qualitative description of the form of the ionospheric equilibrium layer formed in absence of production loss. The layer produced has a latitudinal maximum of N_m, near dip angle of 30°, similar to that of the Appleton anomaly. It is concluded that good agreement would be obtained if electrodynamic drifts were included in attempts to compare theory and experiment above the F2 peak. The final section of this paper presents a possible explanation of the Appleton anomaly. N.E.A.

N65-29279# Science Council of Japan, Tokyo. National Committee for the International Geophysical Coordination.
JAPANESE CONTRIBUTION TO THE INTERNATIONAL GEOPHYSICAL YEAR AND THE INTERNATIONAL GEOPHYSICAL COOPERATION, VOL. VI
M. Hasegawa Nov. 1964 171 p refs

Geophysical observations and research are reviewed for each of the scientific disciplines participating in the international cooperative observation program. Activities are summarized for such programs as world days and communications, meteorology, geomagnetism, aurora and airglow, ionosphere, solar activity, cosmic rays, longitude and latitude, glaciology, oceanography, rockets, satellites, seismology, and nuclear radiation. A brief review of Japanese Antarctic research during the IGC 1959 and post-IGC periods is also included. M.G.J.

N65-29289# National Physical Lab., New Delhi (India).
STATISTICAL CHARACTERISTICS OF SUDDEN IONOSPHERIC DISTURBANCES
A. P. Mitra, C. V. Subrahmanyam, and Mirjana Karabin 15 Feb. 1965 53 p
(RPU-S-19; PL-480-1)

The results of a detailed statistical examination of the relationships between optical observations of solar flares, solar radio noise bursts, magnetic crochets, and various sudden ionospheric disturbances during the period from July 1, 1957 to December 1958 are described. The major conclusions of the study were as follows: (1) The highest percentage association with optical flares occurs with centimeter radio bursts. (2) The sizes of the sudden enhancement of atmospherics and the sudden cosmic-noise absorption correlate with flare importance moderately well but not entirely satisfactorily. (3) For class 1 flares the average time of growth and duration are 9 and 30 minutes, respectively. (4) The occurrence of a sudden ionospheric disturbance was found to occur more often if the level of the flux exceeds a threshold value of 2.20×10^{-20} Wb/meter/cps. (5) The number of sudden ionospheric disturbances decrease linearly with decrease of solar activity. E.E.B.

N65-29438*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
RESONANCES OF THE EARTH–IONOSPHERE CAVITY OBSERVED AT CAMBRIDGE, ENGLAND.
Michael J. Rycroft (Cavendish Lab., Cambridge) [1964] 48 p refs Presented at the Symp. on Ultra Low Freq. Electromagnetic Fields, Boulder, Colo., 17-20 Aug. 1964 Submitted for Publication
(NASA-TM-X-54723) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A program of observations of the natural vertical electric field in the atmosphere in the band 1 to 30 c/s is discussed. After rejection of unwanted signals, the ELF (extremely low frequency) signal is amplified, its waveform being preserved as a photographic record which can be digitized automatically. The power spectral density of the field is computed, and at all times shows statistically significant peaks at 8 and 14 c/s, with evidence of other peaks at 20 and 26 c/s. These are the resonant frequencies of modes of the electromagnetic field in the earth–ionosphere cavity, excited by radiation from lightning discharges. A comparison is made between such spectra and those observed elsewhere. Author

N65-29452*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ELASTIC MODELS OF THE MANTLE CORRESPONDING TO VARIATIONS IN THE EXTERNAL GRAVITY FIELD
William M. Kaula [1963] 33 p refs
(NASA-TM-X-51948) CFSTI: HC $2.00/MF $0.50 CSCL 08E

By modifying earth tide theory to include interior loads, density and stress distributions in the crust and mantle were calculated to correspond to observed variations in the gravitational field plus the surface topography up to 4th degree spherical harmonics. The solutions were made determinate by imposing the condition of minimization of strain energy. For the elastic parameters derived from seismology, the maximum stress difference obtained from the discrepancy between the observed and equilibrium flattenings of the earth was 163 bars. The maximum stress difference found for the sum of all other terms was 97 bars in the lower mantle and 300 bars in the crust. Displacements were always less than 70 meters. Modifications of the solution, taking into account finite strain, creep, and viscous deformation are also discussed. L.S.

N65-29455*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DYNAMICAL BEHAVIOR OF MAGNETOSPHERE BOUNDARY FOLLOWING IMPACT BY DISCONTINUITY IN THE SOLAR WIND
John R. Spreiter and Audrey L. Summers [1964] 16 p refs (NASA-TM-X-54817) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Time histories of the development of the magnetosphere boundary following impact of a sharp-fronted plasma cloud and of the compression of the magnetosphere following impact by a discontinuity in the solar wind are calculated. Results are presented for initially planar discontinuities having their normals either aligned with or inclined 30° to the wind direction. Although several minutes are generally required for a discontinuity in the solar wind to sweep past the geophysically significant portion of the magnetosphere, it is found that any individual element of the magnetosphere boundary usually completes the major part of its adjustment to the new conditions within a period of about a minute. Author

N65-29464*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GRAPHITIZATION OF ORGANIC MATERIAL IN A PROGRESSIVELY METAMORPHOSED PRECAMBRIAN IRON FORMATION
Bevan M. French [1964] 13 p refs Submitted for Publication (NASA-TM-X-51907) CFSTI: HC $1.00/MF $0.50 CSCL 08G

Organic matter in the sedimentary Biwabik iron formation in northern Minnesota shows a progressive increase in crystallinity where the formation is metamorphosed by the intrusive Duluth gabbro complex. X-ray diffraction studies of acid-insoluble residues show a complete range in crystallinity from amorphous material in the unmetamorphosed sediments to completely crystalline graphite adjacent to the gabbro. Author

N65-29493*# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
THE ABSOLUTE PHOTOMETRY OF THE ZODIACAL LIGHT
L. L. Smith, F. E. Roach (Hawaii Univ.), and R. W. Owen [1964] 28 p refs Prepared jointly with Hawaii Univ. Submitted for Publication
(NASA Order R-18)
(NASA-CR-59010) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Interpretation is made of photometric records obtained at the Haleakala Observatory during six nights between August 1961 and June 1962. An interference filter centered on wavelength 5300 A was used. After allowance for the airglow continuum and the integrated starlight, the residual is interpreted as due to zodiacal light. The brightness of the zodiacal light is tabulated for that part observable in the night sky. Graphical representations illustrate the distribution of brightness in ecliptic coordinates. Author

N65-29498*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE AVAILABILITY OF RADIATION DATA FROM THE TIROS II, III, IV, AND VII METEOROLOGICAL SATELLITES
[1963] 2 p Submitted for Publication
(NASA-TM-X-54741) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Results from infrared and visible radiation experiments on the TIROS Meteorological Satellites are now available in various hard copy formats, in addition to the binary Final Meteorological Radiation Tapes, suitable for computer processing, which have previously been available. Detailed descriptions of most of these formats are contained in the TIROS II and TIROS III Radiation Data Catalogs and associated Users' Manuals and in the TIROS IV Radiation Data Catalog and Users' Manual. Information is given as to where investigators may obtain these hard copy data. N.E.A.

N65-29525# Library of Congress, Washington, D. C. Aerospace Technology Div.
OPTICAL AND THERMAL PROPERTIES OF THE ATMOSPHERE Translations of Soviet-Bloc Scientific and Technical Literature
14 Jul. 1965 235 p refs
(ATD-T-65-30)

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14. SPECTROSCOPIC DETERMINATIONS OF THE TOTAL QUANTITY OF WATER VAPOR IN A VERTICAL COLUMN OF THE ATMOSPHERE K. S. Shiffrin and O. Avaste p 209–217 refs (See N65-29539 18-13)

N65-29526 Library of Congress, Washington, D. C. Aerospace Technology Div.
ON THE REGULARITIES OF VARIABILITY OF DAILY TOTALS OF DIFFUSE RADIATION
I. Undla *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 1-11 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 5, 1964 p 24-38 (See N65-29525 18-13)

The nature of variability of daily totals of scattered solar radiation, which includes principles of the methods of climatological calculations for distribution of relative totals, was studied. Results show that in the high and equitorial, and to a certain extent in the temperate geographical latitudes, actual scattered radiation makes up an average of 50% of the total solar radiation. This confirms previous observations that radiation climate depends rather substantially on the conditions of scattered radiation, as climatological distribution of absolute daily totals of effective scattered radiation differs significantly from gauss distribution. W.M.R.

N65-29527 Library of Congress, Washington, D. C. Aerospace Technology Div.
SHORT-WAVE RADIATION REGIME OF A SURFACE COVERED WITH VEGETATION
Yu. K. Ross *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 12-34 refs Transl. into ENGLISH from Moksliniai Pranesimai Lietuvos Tsr Mokslu Akad. Geol. ir Geograf. Inst. (Vilna), v. 5, 1957 p 41-60 (See N65-29525 18-13)

As a result of a series of actinometric measurements a scheme showing the short-wave balance according to distinct components is given for the system soil-vegetation. The formulae for calculating the flow of radiation is derived. The scheme is applied in studying short-wave radiation balance of a rye field. Author

N65-29528 Library of Congress, Washington, D. C. Aerospace Technology Div.
ON THE MATHEMATICAL THEORY OF PHOTOSYNTHESIS OF PLANT COVER
Yu. Ross *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 35-41 ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 157, no. 5, 1964 p 1239-1242 (See N65-29525 18-13)

To establish the most favorable conditions for ensuring maximal utilization of solar radiation energy for crops, a mathematical theory of photosynthesis of plant cover is presented. Modeled as an anistropic turbid medium with given static-geometric structure, equations are developed encompassing such factors as radiation, water-heat and gas regimes of plant cover and soil, mineral nutrition, photosynthesis, respiration, and growth processes. It was concluded that such calculations made theoretical determination of plant productivity in various geographic zones possible. W.M.R.

N65-29529 Library of Congress, Washington, D. C. Aerospace Technology Div.
PHOTOMETRIC ROD FOR DETERMINATION OF DIRECT SOLAR RADIATION IN CROPS AND PLANT COVER
Herbert Niilisk *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 42-45 ref Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 4, 1963 p 120-123 (See N65-29525 18-13)

The development of a photometric rod for determination of direct solar radiation in crops and plant cover is described. It consists of a photocell or photodiode used to detect sunlit spots and to give an approximate relative area of the spots. A relationship between relative attenuation of direct solar radiation and height within plant groupings is shown. W.M.R.

N65-29530 Library of Congress, Washington, D. C. Aerospace Technology Div.
SPECTRAL ALBEDO OF MAIN TYPES OF NATURAL SURFACES IN THE NEAR INFRARED SPECTRAL RANGE
O. Avaste *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 46-59 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz i Astron. (TARTU), no. 4, 1963 p 27-41 (See N65-29525 18-13)

This paper gives a brief review of data on spectral albedo: the vegetation cover, snow, clouds and the sea. The mean values are given for the spectral albedo of the mentioned types of underlying surfaces in the near infrared region of the spectrum. Author

N65-29531 Library of Congress, Washington, D. C. Aerospace Technology Div.
CERTAIN PROPERTIES OF EFFECTIVE COEFFICIENT OF ATMOSPHERE'S TRANSPARENCY
H. Mürk *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 60-64 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 5 p 5-9 (See N65-29525 18-13)

The author considers certain properties of the effective coefficient of transparency, p_{eff} and of the difference $p_{eff} - p_{midday}$. It is shown that: (1) at unvarying transparency, p_{eff} has an appreciable virtual pattern during the year; and (2) the difference $p_{eff} - p_{midd}$ depends on the geographic latitude, time (declination of the Sun), and the atmosphere's transparency. Author

N65-29532 Library of Congress, Washington, D. C. Aerospace Technology Div.
ON THE REDUCTION OF SOME ATMOSPHERE TRANSPARENCY CHARACTERISTICS FROM ONE NUMERICAL VALUE OF SOLAR CONSTANT TO ANOTHER
H. Mürk *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 65-69 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 2, 1960 p 7-14 (See N65-29525 18-13)

Equations were derived for the reduction of some atmosphere transparency characteristics from one numerical value of solar constant to another. Methods for using an actinometric slide rule and nomograms were developed for simplified calculations of the characteristics of the atmosphere's transparency. Equations are developed to show that solar constant variation depends on the relationship to transparency and turbidity factors. W.M.R.

N65-29535 Library of Congress, Washington, D. C. Aerospace Technology Div.
EVALUATION OF THE INFLUENCE OF THE TEMPERATURE DEPENDENCE UPON THE TRANSMISSION FUNCTION OF THE ATMOSPHERE ON THE RESULTS OF THE COMPUTATION OF THERMAL RADIATION IN TERRESTRIAL ATMOSPHERE
Helgi Niilisk *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 132-141 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 5, 1964 p 10-23 (See N65-29525 18-13)

This paper will examine several problems connected with accuracy of radiation nomograms. Calculations have been made of the intensity of upward and downward thermal radiation for three spectral intervals: 5-8.33, 12-18 and 12.86-40

μ. An analysis is given of the results of these calculations and an approximate evaluation of errors connected with ignoring the temperature relationship of the transmission function in these parts of the spectrum. Author

N65-29536 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE PROBLEM OF COMPUTING THERMAL RADIATION OF THE ATMOSPHERE
Helgi Niilisk *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 142–180 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 2, 1960 p 67–114 (See N65-29525 18-13)

Nomograms for measuring radiation in the atmosphere are reviewed and applied to the problem of using graphical methods instead of theoretical and empirical formulas. Radiation nomograms are compared to relate them and to clarify the reasons for the divergence of results, and the advantages and shortcomings of individual nomograms are evaluated. The average typical climatological data concerning the course of fluxes of thermal radiation for various latitudes and altitudes in the troposphere are tabulated. W.M.R.

N65-29537 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE THEORY OF THE RADIATION REGIME OF PLANT COVER
Yu. Ross and T. Nil'son *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 181–198 refs Transl. into ENGLISH from Issled po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 4, 1963 p 42–64 (See N65-29525 18-13)

Modeling plant cover as a turbid layer and solving the equation of transfer of radiant energy for plant cover in the approximation of Schwartzschild, we obtain formulae for calculation of the upward and downward directed flows of radiation originating on account of transmission and diffusion of the direct radiation of the sun and the diffused radiation of the sky falling on the plant cover. Separate flows are considered of short-wave and photosynthetically active (λ = 0.38–0.71 micron) radiation, and a number of conclusions are drawn on the radiation regime of plant cover. Author

N65-29538 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE POSSIBLE SOLARIZATION IN TARTU
I. Undla *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 199–208 refs Transl. into ENGLISH from Issled po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 5, 1964 p 39–50 (See N65-29525 18-13)

An analysis of the conditions of possible diurnal totals of insolation in Tartu from 1954–1960 is given. This takes into account that, under the conditions of the absence of clouds and fogs, the insolation comprises the main part of the total flow of solar radiation. Automatic recording devices were used to gather data. It was shown that the amplitude of variations is increased only slightly as the height of the sun decreases. W.M.R.

N65-29539 Library of Congress, Washington, D. C. Aerospace Technology Div.
SPECTROSCOPIC DETERMINATIONS OF THE TOTAL QUANTITY OF WATER VAPOR IN A VERTICAL COLUMN OF THE ATMOSPHERE
K. S. Shiffrin and O. Avaste *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 209–217 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR, Inst. Fiz. i Astron. (Tartu), no. 4, 1963 p 15–26 (See N65-29525 18-13)

Spectroscopic determinations of the total content of water vapor in the atmosphere by the "method of ordinates" and the "method of areas" are considered. On the basis of data of Howard, Burch and Williams, accuracy is evaluated of solution of the so-called "inverse problem," i.e., determination of the total quantity of water vapor according to semi-empirical functions of absorption in bands—the "method of areas." It is found that the weak bands $\rho\delta T$ (sic—throughout main body of text this expression is $\rho\delta T$) and Φ provide an accuracy of 15–20% for determination of ω. For bands Ψ, Ω, χ the accuracy of determination of ω decreases rapidly with an increase in ω. Author

N65-29540# Air Force Cambridge Research Labs., Bedford, Mass.
GEOLOGY, MINERALOGY, AND HYDROLOGY OF U.S. PLAYAS Environmental Research Papers No. 96
James T. Neal, ed. Apr. 1965 183 p refs
(AFCRL-65-266; AD-616243)

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3. HYDROLOGIC TYPES OF PLAYAS AND CLOSED VALLEYS AND SOME RELATIONS OF HYDROLOGY TO PLAYA GEOLOGY W. S. Matts (Mass. Univ.) p 73–104 refs (See N65-29543 18-13)
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5. GEOPHYSICAL STUDIES OF PLAYA BASINS G. H. Cabaniss p 123–147 refs (See N65-29545 18-13)
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N65-29541 Air Force Cambridge Research Labs., Bedford, Mass.
ENVIRONMENTAL SETTING AND GENERAL SURFACE CHARACTERISTICS OF PLAYAS
James T. Neal *In its* Geol., Mineral., and Hydrol. of U.S. Playas Apr. 1965 p 1–29 refs (See N65-29540 18-13)

Playas in the western United States are found principally in desert basins of the Basin and Range Physiographic Province. Most of the basins were the sites of lakes during the Pleistocene geologic epoch and received large quantities of lacustrine sediment. Thus, many playas are remnants of the ancient lakes, now subject to modification by environmental processes. Playas are highly sensitive to climatologic fluctuations (precipitation, evaporation, wind, temperature) and may periodically alternate from dry to wet surfaces. These surfaces may be correlated with mineralogy and ground-water characteristics. Although playas are remarkably flat and smooth, several processes involving water-table fluctuations are producing giant contraction fissures, phreatophyte mounds, and salt thrust features. Playas may best be characterized as dynamic landforms which are highly sensitive to environmental changes. The changes produce a variety of effects, constantly adjusting to the new environment. Author

N65-29542 Columbia Univ., New York.
MINERALOGICAL FEATURES OF MOJAVE DESERT PLAYA CRUSTS
Paul F. Kerr and Arthur M. Langer *In its* Geol., Mineral., and Hydrol. of U.S. Playas Apr. 1965 p 31–72 refs (See N65-29540 18-13)
(Contract AF 19(604)-8387)

Mineralogical observations and physical measurements have been made on crustal samples of the Mojave Desert playas. Quartz and feldspar are the most plentiful components of granular crustal material; halite is characteristic of salt pavements; carbonates and sulphates characterize clay playas; and chloride, carbonate, and sulphate minerals are found in puffy, wet, and compound crusts. The abundance of colloidal-size particles of sheet silicates is found to have a bearing on crustal strength, shrinkage, dehydration rate, compaction, and permeability. Particle size combined with permeability and compaction may be indicators of water tables below the crust. The more permeable crusts with puffy surfaces are considered indicative of water closer to the surface. The present-day argillic playa crusts are believed to demonstrate original coagulation and settling in enclosed saline basins which occurred during the Pleistocene period. M.W.R.

N65-29543 Massachusetts Univ., Amherst.
HYDROLOGIC TYPES OF PLAYAS AND CLOSED VALLEYS AND SOME RELATIONS OF HYDROLOGY TO PLAYA GEOLOGY
Ward S. Motts *In its* Geol., Mineral., and Hydrol. of U.S. Playas Apr. 1965 p 73–104 refs (See N65-29540 18-13)
(Contract AF 19(628)-2486)

Playas are situated in closed valleys having a variety of hydrologic patterns. Water entering the basin as ground water may flow through, around, or under a playa, and some, all, or none of it may discharge through the playa surface. Each degree of interchange may produce a distinctive set of surface conditions which have control on the development of soils, landforms, and vegetation. Because playas appear to be greatly influenced by hydrology, several classifications of playas relating the composition and amount of discharge of ground water are possible. The rate and amount of ground-water discharge appear to directly control solutioning, deflation, and phreatophyte and spring-mound growth. Falling water tables may produce large-scale desiccation phenomena, and also contribute to degree of aggradation. Author

N65-29544 Air Force Cambridge Research Labs., Bedford, Mass.
TECTONIC INFLUENCES ON PLAYA MORPHOLOGY
James T. Neal *In its* Geol., Mineral., and Hydrol. of U.S. Playas Apr. 1965 p 105–121 refs (See N65-29540 18-13)

Playas in western middle North America are located in arid basins that have undergone a complex geologic history, much of which is still unclear. The complexity of the geology does not determine if a playa will exist in a particular basin, for playas are found in much less complicated geologic regions of the world. Rather, it is a combination of topographic, meteorologic, hydrologic, and historical geologic effects that determine their emplacement. Tectonic and structural manifestations in playas are numerous. Specific cases are demonstrated which show effects of faulting, isostatic readjustment, thermal springs, and large-scale contraction in the playa sediments. These features are frequently obscure, but with some certainty it can be predicted that more effects of tectonism will be noted as playas are studied in greater detail. Author

N65-29545 Air Force Cambridge Research Labs., Bedford, Mass.
GEOPHYSICAL STUDIES OF PLAYA BASINS
Gerry H. Cabaniss *In its* Geol., Mineral., and Hydrol. of U.S. Playas Apr. 1965 p 123–147 refs (See N65-29540 18-13)

Geophysical studies made by several universities and government agencies of some of the interior basins of California and Nevada have revealed that many are partially filled with thick (5000 to 10,000 ft) sequences of Cenozoic sediments and volcanics. Consideration of various geophysical methods (seismic, gravimetric, magnetic, and electrical) and the results from preliminary surveys lead to the conclusion that the seismic techniques are most adaptable to the study of playas, but that electrical methods require additional testing to determine their efficacy in this particular geological environment. Gravity profiles across four playas permit some qualitative interpretation of the structure of the underlying bedrock but show only minor anomalies associated with density variations in the playa sediments. Author

N65-29546 Air Force Cambridge Research Labs., Bedford, Mass.
AIRPHOTO CHARACTERISTICS OF PLAYAS
James T. Neal *In its* Geol., Mineral., and Hydrol. of U.S. Playas Apr. 1965 p 149–176 refs (See N65-29540 18-13)

Playas in the western United States have been studied on aerial photographs, and many of them have been examined in the field. Major types of playa surfaces frequently can be recognized on the basis of albedo, or amount of light reflection. Geomorphic features that can be observed include sheet wash stains, giant contraction polygons, giant contraction stripes, salt pressure polygons, phreatophytes, hot and cold springs, and surface drainage form. Recognition and understanding of the environmental occurrence of these features enable the prediction of surface properties and the ground-water characteristics of the basins. Author

N65-29547# California Inst. of Tech., Pasadena. Seismological Lab.
UPPER MANTLE STRUCTURE OF WESTERN NORTH AMERICA FROM APPARENT VELOCITIES OF P WAVES
Mansour Niazi and Don L. Anderson May 1965 36 p refs *Its* Contrib. No. 1346
(Contract AF 49(638)-1337; ARPA Order 292-63)
(AD-616298)

Variation of the compressional velocity with depth in the C-region of the upper mantle in western North America is studied. Apparent velocities of first arrivals across the Tonto Forest Array in Arizona was determined for about 70 shallow focus earthquakes. The epicenters range from 10 to 30 degrees in distance and are mostly south of the array. The method gives the slope of the travel time curve directly, the parameter required for a velocity-depth determination. For this distance range it is found that although the slope of the P travel time curve decreases substantially with distance, i.e., increasing apparent velocity, the variation is not uniform. Two relatively abrupt changes are observed at distances of about 17 and 24 degrees. These are most readily interpreted as two second order discontinuities in the region of the mantle above 1000 km. Assuming an average crustal structure as derived from seismic refraction measurements and taking the uppermost 200 km of the mantle given by Gutenberg or Jeffreys, various possibilities are explored for the form of variation of the P wave velocity with depth. The discontinuities in the rate of change of velocity with depth which cause the observed breaks in the apparent velocity curve are found to be at depths of about 320 and 640 km. Although no absolute times are required in the method the travel times for the various derived models are computed and compared with standard tables. Author

N65-29550*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONTRIBUTIONS TO THE COSPAR MEETING, May 1964
Washington, NASA, Jul. 1965 179 p refs
(NASA-TN-D-2798) CFSTI: HC $5.00/MF $1.00 CSCL 04A
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12. MEASUREMENT OF LOW ENERGY PRIMARY COSMIC RAY PROTONS ON IMP 1 SATELLITE F. B. Mc Donald and G. H. Ludwig p 175–179 refs (See N65-29562 18-29)

N65-29551* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INFERENCES OF STRATOSPHERIC AND MESOSPHERIC CIRCULATION SYSTEMS FROM ROCKET EXPERIMENTS
G. Warnecke and W. Nordberg *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 1–12 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00 CSCL 04A

Synoptic rocket grenade experiments and meteorological rocket network soundings performed during the winter seasons 1962/63 and 1963/64 were interpreted to show the existence and movement of conventional circulation systems throughout the upper stratosphere and in the mesosphere. Pressure maps for North America were derived from the rocket measurements at various altitudes up to 70 km. Considerable disturbances were found in the zonal pressure distribution at all altitudes. These disturbances were observed to persist several days and some moved considerable distances during that period. Although these disturbances exhibit depths of 10 to 20 km, no clear cut relationship between such systems in the stratosphere and mesosphere could be found. Evidence of such moving pressure systems exists only up to 70 km where the nature of the circulation changes abruptly. The regular wind pattern primarily determined by the circumpolar pressure distribution disappears at altitudes above 70 km, and rocket wind measurements indicate that other forces, probably tidal in nature, become exceedingly predominant above 70 km. At these altitudes, we may only conclude that the nature of the circulation is radically different from lower altitudes, but because of the rapid variation in the wind patterns, we were unable to show the existence of pressure systems such as we found below 70 km. Author

N65-29552* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRATOSPHERIC TEMPERATURE PATTERNS BASED ON RADIOMETRIC MEASUREMENTS FROM THE TIROS VII SATELLITE
W. Nordberg, W. R. Bandeen, G. Warnecke, and V. Kunde *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 13–36 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

The TIROS VII meteorological satellite carried a sensor to map the emitted terrestrial radiation in the 15μ carbon dioxide band. The spectral response of the sensor ranged from 14.8 to 15.5μ. The radiation observed by the satellite is a function of the temperatures of the atmosphere varying along the optical path. Atmospheric layers at various altitudes contribute to the observed radiation in varying amounts. temperature measurements demonstrate on a global scale the varying patterns of stratospheric temperatures and circulation. Temperatures increased at high latitudes toward the summer pole (250° K) and rapidly decreased toward the winter pole (200° K). A fairly uniform region with temperatures generally around 230° K extended between 25° latitude of the summer hemisphere and 40° latitude of the winter hemisphere during solstices. During both equinoxes, the large latitudinal temperature gradients at high latitudes disappeared and differences of about 10–15° K existed with latitudes as well as with longitude. Winter temperature patterns in both hemispheres exhibited strong temperature gradients between the pole and 40°, but a completely uniform pattern never existed in either winter hemisphere. Author

N65-29553* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEW KNOWLEDGE OF THE EARTH'S ATMOSPHERE FROM THE AERONOMY SATELLITE (EXPLORER XVII)
N. W. Spencer, G. P. Newton, C. A. Reber, L. H. Brace, and R. Horowitz *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 37–50 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

The Explorer XVII satellite performed direct, very localized measurements of the total neutral particle density, the concentration of neutral particle masses 4, 14, 16, 28, and 32 and the temperature and concentration of thermal electrons. Pressure gages on the satellite showed that the total density at 280 km was about 50 percent lower than is given by the appropriate atmospheric models based on satellite drag measurements. Daily variations in total density are more strongly dependent on the magnetic index than had been believed previously. Neutral mass spectrometers showed that He is the predominant neutral constituent above 600 km, O is predominant between 250 and 600 km, and N_2 is predominant below 250 km. Langmuir probe results confirmed the global extent of thermal non-equilibrium ($T_e > Tg$) and provided high resolution of the diurnal variation of electron temperature and density at several stations. A consistent and strong latitude effect, evident particularly at Blossom Point, caused a significant positive gradient in electron temperature (the order of 25° K/degree of latitude) and an inverse gradient in electron density in a manner approximately in accord with recent theories of Hanson and Dalgarno. Author

N65-29554* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE TEMPERATURE OF CHARGED PARTICLES IN THE UPPER ATMOSPHERE

R. E. Bourdeau *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 51–62 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00 CSCL 04A

Three general methods of investigating charged particle temperatures in the upper atmosphere have been used: direct measurements from rockets and satellites; indirect determination using electron scale heights measured from rockets and satellites; ground-based radar incoherent backscatter experiments. The latitude, altitude, and temporal trends of these results are reviewed and the implications discussed. Observations show that the electron temperature increases with latitude for both daytime and nighttime conditions. Moderate differences between the daytime electron and neutral gas temperatures are indicated to altitudes well above the F2 peak for a winter mid-latitude ionosphere at an epoch between solar maximum and solar minimum conditions. Much larger daytime differences are observed for summer months and for solar minimum conditions. All of these trends reflect corresponding changes in the electron density. The daytime observations are consistent with ultraviolet radiation as the predominant heat source if the possibility of photoelectrons diffusing along magnetic field lines and depositing their excess energy elsewhere is included. A nighttime heat source is required to explain the observations. Author

N65-29555* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE DIURNAL VARIATION OF THE UPPER ATMOSPHERE

Isador Harris and Wolfgang Priester (NASA, Goddard Inst. for Space Studies) *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 63–75 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

The diurnal variation of the upper atmosphere as revealed from satellite drag measurements has been further investigated on the basis of a simultaneous integration of the heat conduction equation and the hydrostatic law. In addition to the heat source due to absorption of solar extreme ultraviolet radiation and the hypothetical "second heat source," the heating due to absorption of solar radiation in the Schumann–Runge range by oxygen molecules has been included. Neither the effects of time-dependent variations in the boundary conditions on the phase and amplitude of the diurnal variation in the upper thermosphere and exosphere have been investigated. The inclusion of absorption of solar radiation in the Schumann–Runge band by O_2 molecules in our heat source nor diurnal variations of the boundary conditions at 120 km can be invoked in order to explain the diurnal variation on the basis of an EUV heat source exclusively. The effect of horizontal conduction is found in a simplified analysis to be quantitatively insufficient to account for an energy transport toward the west large enough to explain the observed diurnal variation under the presumption that all heating comes from the solar EUV radiation. Author

N65-29557* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INITIAL RESULTS OF THE IMP I MAGNETIC FIELD EXPERIMENT

Norman F. Ness, Cleli S. Scearce, and Joseph B. Seek *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 87–142 refs Submitted for Publication (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

The Interplanetary Monitoring Platform (IMP I), Explorer XVIII has provided the first accurate measurements of interplanetary magnetic fields. The initial apogee of the satellite was located 197,616 km on the sunlit side of the earth, with an apogee-earth-sun angle of 25°. The strength of the interplanetary magnetic field is found to vary between 4 and 7γ with extreme values as low as 1 and as high as 10γ. The magnitude, however, is extremely stable over time scales of hours, although directional changes are significant. The average direction of the interplanetary magnetic field lies slightly below the plane of the ecliptic and approximately along the streaming angle predicted for a steady state solar wind. A significant feature of the magnetic field measurements is the discovery of fields pointed diametrically opposite the streaming angle indicating filamentary structure of interplanetary fields. The discovery at 13.4 R_E of the collisionless magnetohydrodynamic shock wave at the stagnation point associated with the super Alfvénic flow of solar plasma is one of the major results of this experiment. The transition region between the shock wave and the magnetopause is one of high turbulence in the magnetic field. Author

N65-29653*# Illinois Univ., Urbana. Electrical Engineering Research Lab.

A THEORETICAL AND EXPERIMENTAL STUDY OF THE IONOSPHERE USING RADIO SIGNALS FROM EARTH SATELLITES Progress Report No. 9, 1 Jan.–30 Jun. 1964

G. W. Swenson and K. C. Yeh 16 Jul. 1964 5 p refs (Grant NsG-24-59)

(NASA-CR-58661) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Research on the morphology of the ionosphere continued, using as the general method the observation of perturbations induced by the ionosphere on radio signals from earth satellites. The principal subjects under investigation are the study of small scale ionospheric irregularities by means of scintillation of radio signals from satellites, and the total electron content of the ionosphere by observation of the Faraday rotation of the planes of polarization of radio signals from satellites. C.T.C.

N65-29680*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RELATION BETWEEN THEORETICAL AND OBSERVATIONAL MODELS OF THE UPPER ATMOSPHERE

I. Harris and W. Priester (Bonn Univ. Obs.) 5 Jul. 1963 16 p refs

(NASA-TM-X-55239; X-640-63-145) CFSTI: HC $1.00/MF $0.50 CSCL 04A

A comparison is made between theoretical working models and observational models of the atmospheric properties and their changes during the decreasing phase of solar activity. Good agreement is found for all levels of solar activity if the large density changes during the solar cycle are considered. However, in the theoretical models a systematic deviation appears towards the lowest level of solar activity. Better agreement is obtained if the amount of helium is increased by a factor of 2.5 at the boundary of 120 km during these low activity periods. Various graphs are used to illustrate the comparisons. R.N.A.

N65-29686# Weapons Research Establishment (Australia).

FALLING SPHERE RESULTS FOR WOOMERA AND CARNARVON DURING JULY 1964

P. H. O. Pearson Apr. 1965 59 p refs (WRE-TN-PAD-103)

A series of eight HAD rocket vehicles containing inflatable spheres were fired over a period of five days. Useful measurements of density, temperature, pressure and wind values in the upper atmosphere were obtained. All of the firings were

conducted within 1 1/2 hours of local midday in order to nullify, to a great extent, diurnal effects and therefore afford a comparison of variations in space and time. Author

N65-29722*# Geophysics Corp. of America, Bedford, Mass. GCA Technology Div.
STUDY OF EARTH'S ATMOSPHERE Final Report
R. Minzner Apr. 1965 98 p refs
(Contract NASw-976)
(NASA-CR-64008; GCA-TR-65-11-N) CFSTI: HC $3.00/MF $0.75 CSCL 04A

A number of scientific problems relative to studies of the Earth's atmosphere were investigated and the results are presented. Included are studies on atmospheric structure data, planetary atmospheres generated from solar radiation and absorption considerations, analytical investigation of the existence of successive isopycnic layers, temperature determination from diffusion data, and proposed transition model atmospheres and problems associated with their generation. Two other studies are included in the appendix: low mesopause temperatures over the Eglin test range deduced from density data and temperature determination of planetary atmospheres. R.N.A.

N65-29774*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
SATELLITE MEASUREMENT OF ATMOSPHERIC STRUCTURE BY STELLAR REFRACTION
F. F. Fischbach, M. E. Graves, P. B. Hays, and R. G. Roble Apr. 1965 118 p refs
(Contract NASr-54(08))
(NASA-CR-64045) CFSTI: HC $4.00/MF $0.75 CSCL 04A

The technique for deducing atmospheric structure from satellite measurements of refracted starlight is critically examined by relating errors in pressure and temperature to equipment errors. Graphical results are presented, enabling the evaluation of star-tracking accuracy required to meet any given pressure or temperature accuracy. Rigorous analyses of starlight transmission through the atmosphere and background sky brightness are reported, enabling the calculation of star-tracker signal-to-noise ratios and completing the specifications necessary to a design. Occultation geometry has been revised and is presented in graphical form. Results of a preliminary cloud cover analysis are included. Author

N65-29791# Weapons Research Establishment (Australia).
TWO FALLING SPHERE RESULTS AT CARNARVON ON 22nd OCTOBER 1964
P. H. O. Pearson Apr 1965 23 p refs
(WRE-TN-PAD-102)

A series of four HAD rockets were fired at Carnarvon in October, 1964. Of these, two gave useful density, temperature, pressure and wind results. Both of the successful firings were on the same day, the 22nd October, 1964. The first was fired shortly before local dawn and the second shortly after local dusk, and it is these results that are presented in this note. A general increase is shown in density and pressure at all levels in the dusk results compared with the dawn values, the increase being more dominant at the mesopause. The temperature results at the mesopause show a marked increase in value at dusk together with an apparent lowering of the base of the mesopause. Author

N65-29795# Air Force Cambridge Research Labs., Bedford, Mass.
THE PRODUCTION AND REMOVAL OF IONIZATION IN THE UPPER ATMOSPHERE
G. J. Gassmann Buenos Aires, Argentine National Commission on Space Research, 1965 126 p refs Courses held at the Latin Am. School of Physics, Tucuman, Arg., Jul. 1964
(CNIE-PE-4)

Various facts and concepts on production and removal of ionization in the upper atmosphere are presented. Among the topics discussed are: (1) *Atmospheric Profiles*—the standard atmospheres, the number densities, and the electron collision frequencies; (2) *Radiation Input and Production of Ionization*—analytical treatment of radiation flux, and various radiation inputs and ionization processes; and (3) *Removal Processes and the Balance of Ionization*—phenomenology, empirical definitions, diffusion, and chemionization. R.W.H.

N65-29797# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SYNCHRONOUS OBSERVATIONS OF THE "ECHO-1" FOR GEODESIC PURPOSES
D. E. Shchegolev, A. G. Masevich, and B. G. Afanas'ev [1964] 5 p ref Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, 1964 p 74–77

The method of cosmic triangulation by synchronous observations of bright artificial earth satellites such as Echo I can be used for solving problems in higher geodesy, including the geodetic foundation of electrophotographic surveys in inaccessible areas, the determination of coordinates of individual objects in Antarctica, and the connections between islands and continents. Cosmic triangulation makes use of simultaneous observations from two or more stations, and all stations take their photographs according to a specified program and at definite time intervals. The track of Echo I appears on a negative as a chain of points, and images of stars are obtained to permit determination of visible equatorial coordinates of the satellite. It is reported that reliable cosmic triangulation is obtained for distances between 3000 and 4000 kilometers, and that synchronized observations have been obtained when the stations were separated by more than 5000 kilometers. M.W.H.

N65-29803*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ON THE DIFFERENCE BETWEEN PERIGEE AND THE POINT OF MINIMUM HEIGHT ABOVE THE EARTH'S SURFACE
Martin Levy Apr. 1965 25 p
(NASA-TM-X-55244; X-547-65-81) CFSTI: HC $1.00/MF $0.50 CSCL 08E

The point of minimum height above the earth's surface does not occur, in general, at perigee. The combination of the dynamical and geometrical effects of the oblateness will cause this to be true. The result holds, however, even by virtue of the geometrical effect alone. In other words, this effect is associated not only with a perturbed orbit, but also with the mean elliptic orbit which approximates to it. This paper shows that, in this sense, the geodetic latitude of minimum height and the geodetic latitude at perigee are different. Also, formulas for finding the minimum distance between two ellipses are developed. N.E.A.

N65-29817*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONJUGATE INTERSECTS TO SELECTED GEOPHYSICAL STATIONS

J. G. Roederer, W. N. Hess, and E. G. Stassinopoulos Apr. 1965 130 p refs Presented at the COSPAR Panel on Conjugate Point Expt., Buenos Aires

(NASA-TM-X-55260; X-642-65-182) CFSTI: HC $4.00/MF $1.00 CSCL 08N

Geomagnetic field lines are traced into space for more than 500 geophysical stations, using the 48-term Jensen and Cain field expansion for 1960. Total field intensity, magnetic dip, declination, and L-values are computed at each station, and at points 300 and 400 Km vertically above. Coordinates and B values of the conjugate intersects and of the equatorial (minimum B) points are determined for each field line, as well as the total arc length of the line between origin and conjugate intersect. Author

N65-29818*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ROCKET OBSERVATIONS OF THE STRUCTURE AND DYNAMICS OF THE MESOSPHERE DURING THE QUIET SUN PERIOD

W. Nordberg, L. Katchen, J. Theon, and W. S. Smith Apr. 1965 46 p refs Presented at COSPAR, Meeting, Buenos Aires, May 13–19, 1965

(NASA-TM-X-55251; X-651-65-154) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Pressure, density, temperature and wind measurements in the upper stratosphere and in the mesosphere resulted from a total of 53 Pocket-Grenade soundings conducted during the period 1960 to 1965. Most of the soundings were performed over North America (Wallops Island, 38° N and Churchill, 59° N), but some results were also obtained over the tropical Atlantic (Ascension Island, 7° S) and over Northern Europe (Kronogard, 66° N). Soundings were carried out simultaneously at these sites and were coordinated with soundings measuring similar parameters over other areas of the globe. A detailed description of the seasonal and latitude variations in the structure and circulation of this region of the atmosphere is given and compared with IGY measurements. N.E.A.

N65-29841# Emmanuel Coll., Boston, Mass. Research Language Center.

TRANSLATED TABLES OF CONTENTS OF CH'I-HSIANG HSUEH-PAO (ACTA METEOROLOGICA SINICA)

Bedford, Mass., AFCRL, Jun. 1964 15 p Transl. into ENGLISH from Acta Met. Sinica (Peking), v. 34, no. 1, 1964

(Contract AF 19(628)-3869)

(E-TC-CH-64-25; AD-615956)

Abstracts are presented on meteorology and associated subjects to include atmospherics, dynamics, instabilities, spectral analysis, heat balances, ice formation, radiation, ionization, winds, and circulation in the upper troposphere. E.E.B.

N65-29880# Joint Publications Research Service, Washington, D. C.

PLAN FOR A COMMON WORLDWIDE SPACE TRIANGULATION NETWORK

I. D. Zhongolovich 3 Aug. 1965 18 p refs Transl. into ENGLISH from Studia Geophys. Geod., Ceskoslov. Akad. Ved (Prague), no. 9, 1965 p 185–200

(JPRS-31397; TT-65-31894) CFSTI: $1.00

A plan is suggested for establishing a global space triangulation network to solve problems concerning the shape and dimensions of the earth. It would consist of about 12 space stations determined by synchronous observations of a special artificial satellite at an altitude of approximately 12 000 km. The scale of this network is to be determined by measurements of a space baseline using the method of laser beams. Under certain assumptions concerning the accuracy of observations, the distance, which is a function of the earth's radius, can be determined with an accuracy of about ±20 meters. C.T.C.

N65-29902# Utah Univ., Salt Lake City. Dept. of Geophysics.

TABLES OF ENERGY RATIOS, AMPLITUDE RATIOS, AND PHASE ANGLES FOR PLANE SV WAVES VESIAC Special Report

John K. Costain and Kenneth L. Cook Ann Arbor, Mich., Mich Univ., May 1965 112 p refs

(Contract AF 19(628)-201; ARPA SD-78; Proj. Vela Uniform) (Rept.-4410-96-X; AD-463173)

This report presents tabulations of energy ratios from Knott's energy equation, amplitude ratios from the Zoeppritz equations, and phase angles computed from the complex amplitude ratios for a plane SV wave incident on a plane elastic discontinuity. All computations were programmed in FORTRAN for an IBM 7040 digital computer. For a Poisson's ratio of 0.250, incident angles were varied from 0° to 88° in increments of 2°, except near phase change of 180° in the real domain and near the critical angles where the ratios were calculated in increments of 5°. Both real and imaginary coefficients were considered in the calculations. The varying parameters were the velocity ratio and density ratio across each interface, and the angle of incidence. Compressional velocity ratios (transmitted/incident) of 0.700, 0.800, and 0.900, and density ratios (transmitted/incident) of 0.700, 0.800, 0.900, and 1.000 were used. The data are presented in 24 tables. Author

N65-29925# Library of Congress, Washington, D. C. Aerospace Technology Div.

AERIAL PHOTOGRAPHY USED IN MAPPING VEGETATION AND SOILS Translations of Soviet-Bloc Scientific and Technical Literature

27 May 1965 143 p refs Transl. into ENGLISH of the book "Opyt Kartirovaniya Rastitel'nosti i Pochv po Aerosnimkam" Moscow, Science Publishing House, 1964 p 1–162

(ATD-T-65-29; AD-465778)

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9. GEOMORPHOLOGICAL MAPPING WITH SOIL-RECLAMATION RESEARCH USING AERIAL SURVEYING MATERIALS V. G. Mozhayeva p 197–217 refs (See N65-29934 18-13)

10. SOIL-RECLAMATION MAPPING ON THE BASIS OF AERIAL SURVEYING MATERIALS IN THE SARPIN DEPRESSION Ye. I. Vavilov, V. V. Kuznetsov, and N. N. Semenova p 218–237 refs (See N65-29935 18-13)

N65-29926 Library of Congress, Washington, D. C. Aerospace Technology Div.

INTERPRETING FORESTS FOR THE PURPOSES OF MAPPING

A. M. Berezin and I. A. Trunov *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 4–23 refs (See N65-29925 18-13)

Discussed are methods for determining the assaying qualities of forests and the cartographic image of vegetation. Focused on is the significance of aerial photography and uncontrolled photo-mosaics to forest mapping. The type of aerial film, the scale of aerial photography, the season, and photographic apparatus, are discussed in view of their significance to contour interpretation and the accurate determination of vegetation composition. Summer color spectrozonal aerial photographs with a scale of 1:10,000 are recommended for increasing the accuracy of observations. S.C.W.

N65-29927 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE INTERPRETING AND MAPPING OF THE SOIL COVERING IN THE FOREST ZONE FROM THE EXAMPLE OF BELORUSSIA

Ye. I. Vavilov *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 24–39 refs (See N65-29925 18-13)

The feasibility of characterizing solils in forest zones on the basis of aerial photographic data was studied. Presented are results of field and laboratory studies of plowed-, forest-, meadow-, and swamp-soils, in the territory of Belorussia. Described are techniques used to interpret data from black and white-, and color spectrozonal-aerial photographs; and methods used to compile soil maps. Considered in the interpretation of data were soil composition and moisture content. It was concluded that the combined use of aerial survey photographic data and data from field research increases the accuracy of soil maps, and can be useful in interpreting the farming-production characteristics of land resources. S.C.W.

N65-29928 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE USE OF PHOTOSURVEYING MATERIALS IN THE LARGE-SCALE MAPPING OF THE FOREST-STEPPE AND STEPPE VEGETATION OF NORTHERN KAZAKHSTAN

Ye. V. Leont'yeva *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 40–65 refs (See N65-29925 18-13)

The feasibility of using aerial photographic data to compile large-scale maps of vegetation was studied. Reported is an evaluation of individual large-scale maps of the forest-steppe and steppe vegetation of northern Kazakhstan which were compiled from uncontrolled photo-mosaics and aerial photographs. Discussed are inherent problems associated with instrumentation, measurement errors, and human interpretation of data. Also considered are proposed methods for evaluating measurement errors on the working area of aerial photographs and photomosaics. S.C.W.

N65-29929 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE CLASSIFICATION AND MAPPING OF DESERT VEGETATION COMBINATIONS IN CENTRAL TURKEMENIA ACCORDING TO THE MATERIALS OF AERIAL SURVEYING

B. V. Vinogradov *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 66–93 refs (See N65-29925 18-13)

The use of aerial surveying techniques in large-scale geobotanical mapping for purposes of classifying, coordinating, and interpreting data on desert vegetation and natural resources was studied. Analyzed are methods used to establish and classify combinations of plant associations on the basis of the landscape principle; and systematic and geometric principles for taxonomically generalizing the contours of geobotanical maps. Results of experimental studies in the Karakum sands demonstrated that the use of aerial surveying methods increased the accuracy of data on the structure of contours, raised the concrete quality of map content, and enabled the introduction of quantitative criteria for generalizing systematic detail, geometric size, composition, and ratio components, of large-scale maps. S.C.W.

N65-29930 Library of Congress, Washington, D. C. Aerospace Technology Div.

MAPPING SOILS OF A DESERT ZONE IN THE EXAMPLE OF WESTERN KAZAKHSTAN

V. V. Kuznetsov *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 94–106 refs (See N65-29925 18-13)

A study on the use of aerial surveying materials for mapping the soil of desert landscapes is reported. Described are field and laboratory techniques used to compile soil maps in western Kazakhstan. On the basis of aerial surveying materials (uncontrolled photo-mosaics, black and white contact prints, and reproductions of rough mosaic mountains), it was demonstrated that the combined use of aerial photographic data and data from field research increased the quality of map content, and allowed the classification of soils according to mechanical composition, humus content, moisture content, and salinity. S.C.W.

N65-29931 Library of Congress, Washington, D. C. Aerospace Technology Div.

NATURAL ZONING OF SHALLOW WATER AREAS ALONG THE BLACK SEA SHORES OF TAMAN' PENINSULA (FROM AERIAL SURVEYING MATERIALS)

K. M. Petrov *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 107–139 refs (See N65-29925 18-13)

Presented are data designed for use in establishing the natural zoning of the shallow water areas along the Black Sea shores of the Taman Peninsula and the Northwestern Caucasus. Considered are the patterns in the distribution of both individual

natural elements and entire physical-geographical complexes in the shallows and along the shore. Included are data on: the tectonic structure of the area; relief; climate, rivers, soils, and vegetation of the shore lines; sea hydrology (basic current and coastal circulations); recent sea bottom sediments; the biocenoses of the sea bottom; the physical-geographic regions of the coast and sea bottom; and the distinguishing features of the aerial photographic image of the coast and sea bottom. S.C.W.

N65-29932 Library of Congress, Washington, D. C. Aerospace Technology Div.

THE EXPERIENCE OF INTERPRETING AND MAPPING FODDER LAND ON DESERTS AND SEMI-DESERTS FROM AERIAL PHOTOGRAPHS

B. V. Vinogradov and Ye. N. Kudryavtseva *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 140–181 refs (See N65-29925 18-13)

Interpreting features and criteria for establishing production contours were determined from small-scale aerial photographs of pasture and hay lands of arid zones in the Soviet Union. The most important criterion for subdividing the types of fodder land into production contours is to determine the quantitative ratios for components of vegetative combinations. Interpreting the density, dimensions, closeness and vitality of the vegetative specimens in the combinations gives a second group of features for identifying production contours. A third group of characterizing features consists of the relief, the solidness of the sands, the mechanical compositions and salinity, the composition of the soil, the conditions of surface and ground moisture which determine the farming state of the land. It was also found that fodder lands can be categorized into eight general classes on the basis of aerial photographs scaled down as small as 1:17 000. J.M.D.

N65-29933 Library of Congress, Washington, D. C. Aerospace Technology Div.

MAPPING THE GROUNDWATER IN SOIL-RECLAMATION RESEARCH IN THE SEMI-DESERT REGIONS OF THE CASPIAN AREA ON THE BASIS OF AERIAL SURVEYING MATERIALS

K. Ye. Nefedov *In its* Aerial Phot. used in Mapping Vegetation and Soils 27 May 1965 p 182–196 (See N65-29925 18-13)

Aerial photography was used to conduct a hydrogeological mapping study of a 4,000 sq km arid region in the Soviet Union. This semi-desert zone represents a sharply continental climate and is a marine accumulative plain marked by small fluctuations in altitude. Mapping of groundwater was done by interpreting aerial photo-mosaics. It was hoped to find landscape components in the photographs which would bear a useful relationship to groundwater. The complex profile method was used in investigating relief, soil, and vegetation covering. In the mosaics of photographs of 1:100 000 scale, it was found that the lower taxonomic units are significant indicators for dividing the landscape. However, the landscape as a whole, rather than its components, must be investigated for evaluating hydrogeological conditions. J.M.D.

N65-29934 Library of Congress, Washington, D. C. Aerospace Technology Div.

GEOMORPHOLOGICAL MAPPING WITH SOIL-RECLAMATION RESEARCH USING AERIAL SURVEYING MATERIALS

V. G. Mozhayeva *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 197–217 refs (See N65-29925 18-13)

An aerial photography method is described which was used for geomorphological mapping and mapping of the lithology of quaternary deposits in a semi-desert region in the Soviet Union. Topographic mosaics of 1:100 000 scale were constructed for selected key areas; study of these areas revealed close relationships between the relief and the geological deposits, and the soil and plant covering. The relationships make it possible to clarify the distribution boundaries for individual landscape components, and to extrapolate from data obtained to areas of the studied region which were not visited in the field. It was concluded that under the conditions of a very flat plain relief as in the semi-desert zone of the Caspian depression, geomorphological mapping should be done only on the basis of aerial photographic materials, since this significantly raises the accuracy. J.M.D.

N65-29935 Library of Congress, Washington, D. C. Aerospace Technology Div.

SOIL-RECLAMATION MAPPING ON THE BASIS OF AERIAL SURVEYING MATERIALS IN THE SARPIN DEPRESSION

Ye. I. Vavilov, V. V. Kuznetsov, and N. N. Semenova *In its* Aerial Phot. Used in Mapping Vegetation and Soils 27 May 1965 p 218–237 refs (See N65-29925 18-13)

The effectiveness of using aerial survey materials on a production scale for soil reclamation and geobotanical mapping is established. Soil reclamation maps of 1:099 000 scale were compiled for a 4000 sq km floodplain area in the Soviet Union. Soil, geobotanical, hydrogeological, and geomorphological maps for the entire study area were compiled along with small scale section maps of plots of 3 and 5 meters. Study of the assembled material showed the natural features in the distribution of the soil covering, and permitted categorization of areas into four soil-reclamation groups, each implying a different course of action in rendering the soil suitable for vegetation. This aerial photographic method makes it possible to base field work on information about natural complexes of an area, to determine the distribution of the basic relief forms, and sometimes to establish the soils and groundwater related to them. J.M.D.

N65-29956*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

HOURLY VALUES OF EQUATORIAL Dst FOR THE IGY

Masahisa Sugiura Jun. 1963 44 p refs

(NASA-TM-X-55238; X-611-63-131) CFSTI: HC $2.00/MF $0.50 CSCL 08E

Using eight magnetic stations in low latitudes, hourly values of Dst are determined for the IGY. Three-hourly mean Dst values are compared with corresponding values based on Kertz's Dst indices. Three-hourly mean Dst is also compared with *ap* indices. It is found that Dst correlates well with *ap* in gross features and that during magnetic storms activity represented by *ap* recovers more rapidly than Dst. Author

N65-29974# Hydronautics, Inc., Laurel, Md.

ON INTERNAL GRAVITY WAVES GENERATED BY LOCAL DISTURBANCES

K. K. Wong Feb. 1965 32 p refs

(Contract Nonr-3688(00))

(TR-231-5; AD-464264)

The internal waves generated by a time dependent local disturbance in an incompressible continuously stratified fluid are examined. Following the Love theory of wave motion in heterogeneous liquids, the motion is regarded as a small perturbation about the state of hydrostatic equilibrium. For simplicity, the equilibrium density profile is taken to be exponential. It was found that, for a disturbance having a simple harmonic time dependency, the ratio of the disturbance frequency to the Vaisala frequency determines whether progressive internal

waves are present or not and in which regions. The propagation of the wave front of the internal waves generated by an instantaneous source was also analyzed. Author

N65-30016# Travelers Research Center, Inc., Hartford, Conn.
CASE STUDIES OF FOG AND LOW CLOUDS IN THE WASHINGTON, D. C. MESONETWORK AREA Final Report
Keith D. Hage and Herbert D. Entrekin Jun. 1965 156 p refs
(Contract FA-65-WA-1192)
(SRDS-RD-65-32)

The spatial representativeness of surface observations at the U.S. Weather Bureau mesonetwork surrounding Washington, D.C. was investigated using autocorrelation coefficients. Network data revealed air-flow disturbances including mesoscale low-pressure centers, windshift lines, and weak cyclonic vortices imbedded in larger-scale low-pressure troughs. Low cloud and fog, associated with some disturbances, were tracked across the network. Low-level wind divergence from time-space means were very useful for identifying and analyzing both moving and stationary disturbances. Level-of-saturation changes due to advective changes in temperature and specific humidity over sloping terrain agreed reasonably well with observed ceiling changes. A canopy-like structure along the forward edge of a moving low-cloud band, was attributed to vertical wind speed shear. Evidence was found of a reduction of wind speed that significantly affects the behavior of low cloud and fog. Under bands or blankets of low clouds, highest station elevations experienced lowest visibilities and most persistent fog; the higher stations experienced less fog during periods of fog blanket within a shallow inversion. Author

N65-30117# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
PENETRATION OF PLATES IN DENSE SNOW
Malcolm Mellor and René O. Ramseier May 1965 16 p refs
(CRREL-RR-151; AD-617617)

As part of a program of snow studies in Greenland, instrumented struts were placed in rooms excavated below the surface of the ice cap. Closure rates were measured in the undersnow cavities, and strut loads developed by snow pressure on the circular end plates were recorded. The strut installations are described and the data are interpreted in terms of Kerr's viscous foundation theory. Emphasis is placed on the penetration of a circular rigid plate, the evaluation of the viscosity coefficients, comments on the values of the parameters for a given material, shear viscosity, and thickness in the Kerr model, and the effect of plate size on penetration rate. It is tentatively concluded that (1) until a suitable treatment for the viscoelastic continuum becomes available, the Kerr model offers a rational approach to problems of foundations in snow and to certain problems involving pressures on undersnow structures, (2) the viscosity coefficients of the model are not in themselves characteristic constants for a given snow, (3) as a consequence of (2), the viscosity coefficients may not be evaluated by comparing data for plates of widely differing sizes, and (4) if the thickness coefficient were found to be independent of plate size, as seems possible, it would become a valuable index for determining size effect. Author

N65-30123# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
MOVEMENT STUDIES BY SEISMIC SOUNDINGS ON THE GREENLAND ICE SHEET, 1956–1959, SITE 2
Hans Roethlisberger, Charles R. Bentley, and Hugh Bennett Apr. 1965 30 p refs
(CRREL-RR-161; AD-617618)

A detailed seismic reflection survey was carried out at Site 2, Greenland (76° 59' N, 56° 05'W) in 1958 in a rectangle 3160 × 2400 ft (963 × 732 m). The survey was repeated in 1959 in the same area, which had been marked by bamboo poles. The results were essentially the same, indicating that the surface had probably not moved much in the 3-year period. However, the reflection records were not of sufficiently high quality to give an accurate estimate of the possible shift, leaving an uncertainty of the order of 50 to 100 m in the direction of the dip of sub-surface (SW) and more in the direction of the strike. It is estimated that under more favorable conditions the method should give an accuracy of 30 to 50 m. Author

N65-30150# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
STUDIES OF DETONATIONS AT IONOSPHERIC ALTITUDES UNDER PROJECT RED LAMP
N. W. Rosenberg, T. D. Conley, S. R. Curley, and A. H. Lorentzen May 1965 45 p refs *Its* AF Surveys In Geophysics No. 163
(AFCRL-65-356; AD-617249)

Project RED LAMP consists of a series of launchings of sounding rockets with chemical payloads. The rockets are launched at the Eastern Test Range for the purpose of: (a) Calibrating radio-frequency research instrumentation which is being used to study rocket phenomena. (b) Determining the position, growth and intensity of rocket-generated shock waves (c) Defining the electron density gradients of the shock wave. The present report consists of two unclassified papers concerning results from two RED LAMP launches during May 1964. The first paper is concerned with the interpretation of radio and optical measurements of these two launches in terms of a spherical expansion of a blast wave. The second paper is concerned with the analogy between spherical and cylindrical explosions at ionospheric altitudes and the relation between point TNT explosions and a rocket plume. Author

N65-30187*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MEASURED ACOUSTIC PROPAGATION PARAMETERS IN THE MISSISSIPPI TEST OPERATIONS AREA
Richard N. Tedrick and Robert C. Polly Washington, NASA, Aug. 1965 52 p refs
(NASA-TM-X-1132) CFSTI: HC $2.00/MF $0.50 CSCL 04A

To investigate the propagation of sound in the Mississippi Test Operations (MTO) area, MSFC initiated a year-long study using a large exponential horn, a U. S. Weather Bureau radiosonde station, and several portable acoustic monitoring systems. Approximately 100,000 acoustic and 1000 atmospheric measurements were made during calendar year 1963. These were summarized with the aid of a large-scale digital computer to present information on the propagation, refraction, and attenuation of low frequency sound in the area. Curves are presented showing the effects of variations in acoustic velocity gradient, humidity and wind at 40, 80, 120, and 160 Hertz (cycles per second). The persistence and repeatability of these propagation conditions were also investigated and are presented. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-29172*# Hughes Research Labs., Malibu, Calif.
RESEARCH ON GRAVITATIONAL MASS SENSORS Quarterly Progress Report No. 2, 15 Jan.–14 Apr. 1965
Robert L. Forward, Curtis C. Bell, and J. Roger Morris [1965] 42 p
(Contract NASw-1035)
(NASA-CR-63894) CFSTI: HC $2.00/MF $0.50 CSCL 14B

In developing a sensor that will detect the presence of a small, nearby moving mass through gravitational interactions, a cruciform sensor head, with associated vacuum chamber, has been built for test purposes. To minimize the signal-to-noise problems, a phase shift tuned amplifier was developed. This is identical to the convention phase shift oscillator circuit, except that it has an input, and its gain is adjusted so that it is not sufficient for oscillation. Tests on an air bearing support and drive were conducted, and a theoretical analysis was made to determine the possible causes of vertical instability. A preliminary analysis of the cruciform sensor was also undertaken in an attempt to optimize the structure parameters. Results show that the cruciform structure is usable as a sensor head in prototype gravitational mass sensor studies, and the available electronic techniques for sensing the vibrational strains, amplifying the signals, and bringing them out from the rotor are adequate. C.T.C.

N65-29202# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MEASURING THE DURATION OF IMPULSES AND FREQUENCY OF OSCILLATIONS
Sh. Yu. Ismailov and A. M. Smolyarov 23 Apr. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 159577 (Appl. No. 806038/26-10, 6 Dec. 1962) 2 p
(FTD-TT-64-1289/1+2; AD-615295)

This paper proposes a device for measuring the length of impulses and frequency of oscillations. The device contains a differential circuit, a trigger, a unit of comparison, a cathode repeater, a circuit of discharge, a circuit of comparison, a reversing counter, and a step-type motor with a reducer. The device is distinguished by the fact that for measuring and recording the length of microsecond single and periodic impulses between the output unit of comparison and the control switch there are connected a storage integrating circuit and a slave multivibrator which extend the difference impulse by the time of the operation of the mismatching. N.E.A.

N65-29205# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
THE ELECTROMAGNETIC ISOTOPE SEPARATOR AS A RESEARCH TOOL
J. H. Freeman May 1964 17 p refs
(AERE-M-1374) HMSO: 3s

Isotope separator behavior is discussed briefly and the possibilities of using machines such as the A.E.R.E. small sector separator as research instruments are discussed in some detail. The separator is considered (1) as an auxiliary for nuclear chemistry studies; (2) as a versatile ion gun capable of giving intense sharply focussed beams for radiation damage and ion interaction studies; (3) as a controllable plasma with attached analyser for the study of the chemistry of gas discharges. It is concluded that the A.E.R.E. separator could become a valuable research auxiliary and that it might be useful for future university collaboration programs. Author

N65-29250# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENTS, AUTOMATION, CONTROL Selected Articles
12 May 1965 27 p refs Transl. into ENGLISH from Pomiary, Automatyka, Kontrola (Poland), no. 10/11, 1963 p 480-487
(FTD-TT-64-1385/1+2; AD-466197)

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N65-29251 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETOMETERS WITH TRANSDUCTOR MAGNETIC CONVERTER
Jan Kulikowski and Maciej Nalecz *In its* Meas., Automation, Control 12 May 1965 p 1-8 refs (See N65-29250 18-14)

Various magnetometers and their applications are described. Magnetometers with converters of selective output are suitable as laboratory instruments for measuring magnetic magnitudes and in defectoscopy. Magnetometers designed with pulsed output converters are simple portable instruments which can be used for measuring terrains when investigating magnetic anomalies. J.M.D.

N65-29252 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METERING DEVICE OPERATING ON THE PRINCIPLE OF THE HALL EFFECT
Andrzej Szulce *In its* Meas., Automation, Control 12 May 1965 p 9-17 refs (See N65-29250 18-14)

Use of the Hall effect for measuring magnetic fields is described. Hall meters both with and without amplifiers are currently in use. These meters are less accurate than standard laboratory devices, such as ballistic galvanometers and fluxmeters, in measuring variable fields but have greater simplicity and ease of handling. The design of a magnetic field intensity meter is presented, based on indium arsenite plates of low resistance, in which compensation is made for the disturbing effect of temperature variation. J.M.D.

N65-29253 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETOMETER WITH HALOTRON FOR MEASURING SMALL MAGNETIC FIELDS
Henryk Ziomecki *In its* Meas., Automation, Control 12 May 1965 p 18-23 refs (See N65-29250 18-14)

A device which uses the Hall effect for measuring small magnetic fields is described. In particular, it is intended for measurement of terrestrial field fluctuation and dc traction line dispersion fields, and for this reason the device includes a transistorized amplifier rather than the photoelectric type used in the laboratory. The basic element of the instrument is a halotron made of indium arsenide, which is powered by ac current with a frequency of 1000 c. The amplifier is sensitive to phase changes and maintains low fluctuations of asymmetry voltage in the halotron. In using this Hall meter, simultaneous measurements eliminate the effect of temperature on accuracy. J.M.D.

N65-29260# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LSU-2 UNIVERSAL SCINTILLATION COUNTER
Waldemar Scharf 14 Apr. 1965 5 p Transl. into ENGLISH from Nukleonika (Warsaw), v. 8, no. 3, 1963 p 213–214
(FTD-TT-64-1367/1+2; AD-462440)

The LSU-2 universal scintillation counter is used for measuring alpha, beta, and gamma radiation of the window and windowless type in a lab. The construction of the counter is outlined, and technical data concerning the operation of its components are summarized. J.L.D.

N65-29261# Itek Corp., Lexington, Mass.
STUDY OF IMAGE-EVALUATION TECHNIQUES Interim Engineering Report No. 12, 15 Apr.–15 Jul. 1965
[1965] 74 p refs
(Contract AF 33(657)-9158)
(ITEK-65-9048-13; AD-466577)

The fundamental characteristics of resolution and transfer function analyses are discussed, and two fundamental differences are observed, i.e., resolution analysis is basically empirical and has a spatial nature, while transfer function analysis is analytical and has a spatial frequency nature. The effect of a wavefront with rapidly varying curvature on the transfer function of a circular aperture is considered. An aberration function in the form of a radially distributed cosine was chosen, and transfer functions are shown for cosine amplitudes of 1/8, 1/4, and 1/2 wavelength and frequencies of $\pi\rho$, $3\pi\rho$, and $7\pi\rho$. Also, the derivation of a new formulation describing the spread function of an aberration free, defocused slit aperture; emulsion studies using coherent light apparatus; statistical analysis of emulsion resolving power threshold data; the effect of rotational alignment on the frequency response of a scan slit used to trace one-dimensional objects; and incorporation of programs into a precision optical model program are covered. The mathematical derivation of two-dimensional Fourier transform is included. E.E.B.

N65-29282# Aeronautical Research Labs., Melbourne (Australia).
TEMPERATURE COEFFICIENT DETERMINATION OF RESISTANCE STRAIN GAUGES
I. G. Scott Jul. 1964 21 p refs
(ARL/SM-290)

Methods for the determination of temperature coefficient of resistance strain gages are reviewed. A new method allowing rapid determination of this parameter is described. The effects of gage drift on temperature coefficient determination are discussed and corrections established. Author

N65-29283# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
VOLUMETRIC CALIBRATION OF PROCESS VESSELS USING DIGITAL COMPUTER TECHNIQUES
L. W. Doher and J. A. Schulz 1 Jul. 1965 65 p refs
(Contract AT(29-1)-1106)
(RFP-488) CFSTI: $3.00

The paper describes a procedure for accurately and speedily calibrating tanks used for the chemical processing of nuclear materials. The procedure features the use of (1) precalibrated vessels certified to deliver known volumes of liquid, (2) calibrated linear measuring devices, and (3) a digital computer for manipulating data and producing printed calibration information. Calibration records of the standards are traceable to primary standards. Logic is incorporated in the computer program to accomplish curve fitting and perform the tests to accept or to reject the calibration, based on statistical, empirical, and report requirements. This logic is believed to be unique. Author

N65-29449*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUTOMATIC RECORDING MC LEOD GAUGE
Paul A. Faeth 8 Jul. 1965 6 p ref Submitted for Publication
(NASA-TM-X-51941) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A modified McLeod gage has been constructed and used to record pressure automatically. The overall design used for the construction of the gage is shown. The electrical circuits of the cycling and measuring portion of gage are described. Operation procedures and a typical plot of the data obtained from operation of the gage are presented. N.E.A.

N65-29490*# Aeronautical Chart and Information Center, St. Louis, Mo.
LUNAR CHARTING PROGRAM Quarterly Progress Report No. 3, 1 Apr.–30 Jun. 1964
[1964] 4 p
(NASA Order R-108)
(NASA-CR-58752) CFSTI: HC $1.00/MF $0.50 CSCL 14E

Activities are reported for the lunar charting program. Lunar negatives, consisting of 1475 9 × 9 in. and 1854 70 mm, were received. Approximately 715 hours of visual telescopic observations were conducted on the 20 and 24 inch refractors. The acquisition of photographic support materials and mensuration support facility equipment is discussed. R.N.A.

N65-29499*# Brandeis Univ., Waltham, Mass.
INERTIAL ROTATION SENSOR
S. P. Heims [1963] 3 p refs Submitted for Publication
(Grant NsG-612)
(NASA-CR-58722) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A new mechanism for inertial rotation sensing devices is presented. In this mechanism a crystal along with spectroscopic equipment is rotated relative to an inertial frame. The equipment measures the spectral lines of the rotating atoms as seen by an observer who is also rotating. The observed characteristic atomic frequencies differ from the corresponding frequencies in a stationary experiment by an amount proportional to and of the order of the rotation frequency itself. Consequently the frequency shifts can be used to detect rotation. R.N.A.

N65-29654*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE NASA-LRC TELESPECTROGRAPH TEST AND OPERATION RESULTS
James M. Satterfield [1964] 25 p Presented at the SPIE 9th Ann. Tech. Symp., Miami Beach, 24–28 Aug. 1964
(NASA-TM-X-51962) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The tracking telespectrograph is a precision instrument used to track the reentry flight of a space vehicle or satellite and record on film a continuous spectrum of its light output and supplementary sequential engineering data with respect to real time. This film is subsequently used to study the physical effects on the leading edge of the reentering vehicle as it passes through the denser layers of the atmosphere. The entire telespectrograph optical package is mounted on a precision, azimuth-elevation tracking mount. A detailed description is given of the components of the tracking telespectrograph assembly and test results of reentry studies are discussed with emphasis on Project Fire spacecraft mission. N.E.A.

N65-29658*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
CONTROLLER USES TRANSISTOR AS A TEMPERATURE SENSOR
Sherwin Greenblatt [1964] 4 p Submitted for Publication
(Grants NsG-496; NSF GP-2495; NIH-MH-04737-04; Contract DA-36-039-AMC-03200(E))
(NASA-CR-58727) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A simple dc proportional temperature controller is discussed, which may be constructed by taking advantage of the predictable variation of transistor parameters with temperature. The variation in collector current with temperature under constant base-emitter voltage conditions was used to provide an oven temperature sensor with power gain. This sensor in connection with two additional transistors is all that's necessary to complete the controller which has a 10-watt drive capability. Operation is similar to any feedback control system, and the performance is comparable to one incorporating a conventional proportional controller with a thermistor temperature sensor followed by a three-transistor amplifier. C.T.C.

N65-29678*# Adcole Corp., Waltham, Mass.
ELECTRONIC INSTRUMENTATION FOR IONOSPHERIC AND EXTREME ULTRAVIOLET RADIATION MEASUREMENTS Final Report
Robert S. Hills 1 Mar. 1965 162 p refs Sponsored in part by NASA
(Contract AF 19(628)-2464)
(NASA-CR-64074; AFCRL-65-417) CFSTI: HC $5.00/MF $1.00 CSCL 09C

This report describes the design, construction, test and flight use of the electronic portions of research instruments used on rockets and satellites for the investigation of ultraviolet solar radiation. These instruments include grating monochromators for measurements in the 55–1300 Angstrom range and proportional counter spectrometers in the 1–10 Angstrom range. Also described is work done on retarding potential analyzers used for analysis of environmental charged particles, including measurement of electron temperature. All the instruments are of a telemetering type. Associated equipment used for calibration and testing of the instruments in both the laboratory and the launch phases is described. Automatic data reduction equipment was developed and used successfully. Experiments involved OSO, OGO and Air Force satellites and Aerobee-150 and Black Brant rockets. Author

N65-29703# Library of Congress, Washington, D. C. Aerospace Technology Div.
AEROSPACE INSTRUMENTATION Surveys of Soviet-Bloc Scientific and Technical Literature
13 Jul. 1965 68 p refs Compilation of Abstracts
(ATD-P-65-49; AD-466884)

This report is the first in a series reviewing Soviet developments in aerospace instrumentation. Abstracts contained in the report were selected from Soviet open literature published in 1964. The 78 abstracts are arranged alphabetically by author within each of the following categories: magnetometers, gravity gradient meters, gas composition analysis, micrometeorite detection, cosmic and corpuscular radiation detection, electromagnetic radiation detection, and pressure sensors. A bibliography is presented at the end of the report. N.E.A.

N65-29746*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
TEST PLAN AND TEST INSTRUMENTATION, RF TEST CONSOLE, APPENDIX K Part of the Final Report
F. A. Trenkle Aug. 1964 67 p ref Prepared for JPL
(Contracts NAS7-100; JPL-950144)
(NASA-CR-64027) CFSTI: HC $3.00/MF $0.75 CSCL 14B

Discussions are presented on the test plans and test instrumentation for a RF Test Console on JPL. A survey of commercial test instrumentation was made to determine those instruments which would meet the requirements of the RF Test Console. The results of this survey are summarized and tabulated. In these tables the instruments of various manufacturers are compared with regard to what are felt to be the most important characteristics. The recommended instruments are listed with the reasons for their selection. At present, it appears that very few special test instruments will be required. The major items will be mixers for up-converting and down-converting the 50 mc signal and at least one external frequency source. These items and their application are summarized. The test plan describes the type of tests and the test instruments to provide performance data of the complete assemblies. N.E.A.

N65-29772*# Spacelabs, Inc., Van Nuys, Calif.
PROPELLANT LEAKAGE DETECTION SYSTEM Final Report
25 Apr. 1965 115 p refs
(Contract NAS9-3427)
(NASA-CR-65069; SR-65-1019) CFSTI: HC $4.00/MF $0.75 CSCL 14B

A prototype Propellant Leakage Detection System (PLDS) has been developed for use with bi-propellant reaction control systems. The PLDS consists of two sensors and an electronic package. One of the sensors is used to detect propellant leaks in the range from 10 cc/hour to 10000 cc/hour. The other sensor operates in the range from 1000 cc/hour to 2×10^5 cc/hour. The electronic package provides power and signal conditioning for the sensors. A test unit was included to facilitate testing of the PLDS. The test unit includes a pilot light for the 28 volt power, a high and low range selector switch, a leak alarm indicator light, and test points for monitoring the performance of the PLDS components. The development of the prototype Propellant Leakage Detection System clearly shows that the design and production of optimized systems for flight use is feasible. Author

N65-29811*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A TRIAXIAL ELECTRON DETECTOR
K. W. Ogilvie, D. L. Lind, and T. D. Wilkerson Apr. 1965 11 p
(NASA-TM-X-55263; X-612-65-192) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A triaxial electron detector for use in a sounding rocket experiment to study polar cap absorption events is described. The detector performs a differential energy analysis on electrons which reach the rocket from three orthogonal acceptance cones of size 6 1/2 degrees × 10 degrees. Electrons diffusing into the entrance slits are accelerated to 100 eV above their original energy. This assures their being comfortably above the detector's low energy threshold and reduces the range of potentials needed for the electrostatic analyzer plates which follow the accelerating grid. The analyzers deflect particles of the correct energy per unit charge through 127° using potentials applied symmetrically above and below the 100 volt accelerating voltage. After the electron energy selection they enter a windowless electron multiplier designated channeltron. The channeltron's output current is compared to a standard current and the difference is used in a servo loop to control high voltage and thus the channeltron gain. A logarithmically compressed analog telemetry signal is derived as a fraction of the applied high voltage. R.N.A.

N65-29812*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SOFT X-RAY PHOTOIONIZATION DETECTOR
R. M. Young and A. K. Stober Apr. 1965 17 p refs
(NASA-TM-X-55257; X-614-65-179) CFSTI: HC $1.00/MF $0.50 CSCL 14B

A simple ceramic radiation detector used in solar and astrophysical observations from rockets and satellites is the direct-current gas-filled ionization chamber. The detector consists of a ceramic shell incorporating a beryllium window and containing Zenon fill gas. The sensitivity is determined by the ion-pair yield of Xenon, along with Xenon's spectral absorption characteristics, and the transmission properties of beryllium. The fabrication technique for these detectors is described, along with some observed operating characteristics. Author

N65-29836 Academy of Sciences (USSR), Moscow. Astronomical Council.
AN ANALYSIS OF THE STABILITY OF A STATIONARY MOUNTED "TZK" TUBE [ANALIZ STABIL'NOSTI STATSIONARNYKH USTANOVOK TZK DLYA NABLYUDENII ISZ V GORIZONTAL'NOY SISTEME KOORDINAT]
V. I. Kuryshev *In its* Opt. Observation Sta. for Artificial Earth Satellites, Bull. No. 36 1963 p 14–21 refs (See N65-29833 18-30)

A stationary mounting for a TZK (image) tube is described and its stability discussed. Proposed are methods for reconstructing these tubes to give an increased accuracy of obtained tracking data (azimuth and height). S.C.W.

N65-29848*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MATHEMATICAL COMPUTATIONS FOR THE AUTOMATIC PICTURE TRANSMISSION SYSTEM-TIROS VIII
Roger D. Werking Apr. 1965 87 p refs
(NASA-TM-X-55259; X-547-65-181) CFSTI: HC $3.00/MF $0.75 CSCL 14E

Spacecraft configuration, information requirements of the automatic picture transmission (APT) ground stations, formulations, formatting of APT messages, and schedules for the preparation and sending of the APT messages for Tiros VIII are given. Data necessary for determining where the pictures were taken and how the camera was oriented are presented. Included are formulations which are peculiar to the APT system. The form in which the daily and weekly messages are output from the APT computer program, and the daily message transmitted to the ground station are discussed. With the real time weather forecasting capabilities of the APT system, a method of supplying the APT station with the latest satellite orientation information has been devised; this schedule is also included. C.T.C.

N65-29874*# Consolidated Controls Corp., Bethel, Conn.
PRESSURE MEASURING SYSTEMS FOR CLOSED CYCLE LIQUID METAL FACILITIES Fifth Quarterly Report, Mar. 1–May 31 1965
Anthony J. Cassano 28 Jun. 1965 43 p refs
(Contract NAS3-4170)
(NASA-CR-54439; CCC-508) CFSTI: HC $2.00/MF $0.50 CSCL 14B

Continuing development of a pressure transducer system for liquid metal applications is described. During the report period, emphasis was placed upon fabrication of an experimental transducer incorporating a thermionic diode sensor. Problems encountered in fabricating the transducer are outlined along with the anticipated solutions. A potassium compatibility test facility has been constructed and checked out. A complete set of single convolution pressure capsules and electrical terminals has been charged with liquid potassium and is undergoing the initial stages of the compatibility test procedure. Preliminary analyses are presented for different configurations of differential pressure transducers. Author

N65-29876# Weapons Research Establishment (Australia).
THE MEASUREMENT OF THE FOUIER SPECTRA OF TRANSPARENCY FUNCTIONS
R. E. Little Apr. 1965 19 p refs
(WRE-TN-ISD-57)

Methods are discussed for measuring the Fourier Spectra of transparency functions and an instrument is described for performing this measurement automatically. The instrument described can also be used as a source of sine wave objects of variable contrast and spatial frequency. Author

N65-29913# Army Electronics Labs., Fort Monmouth, N. J.
AN AC PROBE FOR THE MEASUREMENT OF ELECTRON DENSITY AND COLLISION FREQUENCY IN THE LOWER IONOSPHERE
John G. Mc Coy Jul. 1965 14 p refs
(ECOM-5003; AD-466998)

A dual-frequency AC probe is described for the measurement of electron density and collision frequency in the 60 to 120 km region of the lower ionosphere. The instrument is designed to make measurements after payload separation from the rocket vehicle near rocket apogee in the vicinity of 120 km. Author

N65-29959*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIRBORNE TELEMETRY CALIBRATOR TYPE 4X4 MOD I
Raymond J. Stattel and John S. Fitz Apr. 1965 22 p
(NASA-TM-X-55256; X-671-65-173) CFSTI: HC $1.00/MF $0.50 CSCL 09F

The development and operating characteristics of a new, sixteen channel, airborne telemetry calibrator are described. The unit was designed and developed at Goddard Space Flight Center to fulfill increasingly stringent requirements by scientists and experimenters for enhanced accuracy and reliability in transmitted data, and to meet the needs of the sounding rocket program for a smaller, lighter, more stable unit. The type 4 X 4 Calibrator is now operational as proven, flight qualified equipment. Author

N65-30006# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ARRANGEMENT FOR PHOTOGRAPHING ARTIFICIAL EARTH SATELLITES
M. K. Abele and K. K. Lapushka 14 May 1965 7 p Transl. into ENGLISH from Soviet Patent No. 162748 (Appl. No. 12508/26-10, Jan. 9, 1963) 2 p
(FTD-TT-65-205/1+2; AD-616307)

The device for photographing artificial earth satellites containing blocks for controlling film drive and the angular position of the camera is distinguished by utilization of a controlled telescope-guide which continually tracks the satellite and serves for visual control of compensation of the visible angular velocity. TAB

N65-30007# Thornthwaite (C. W.) Associates, Centerton, N. J. Lab. of Climatology.
RECENT DEVELOPMENTS IN METEOROLOGICAL SENSORS AND MEASURING TECHNIQUES TO 150,000 FEET. PART II: BIBLIOGRAPHY Final Report

John R. Mather, ed. 30 Apr. 1965 197 p refs
(Contract DA-28-043-AMC-00001(E))
(AD-616396)

A survey was made of recent developments in meteorological sensors and measuring techniques from the surface up to an altitude of 150,000 feet. The results are presented as an annotated bibliography of 698 items, plus an analysis of the current status and of promising developments. Modes of atmospheric parameters covered are: temperature, pressure, humidity, wind, density, radiation flux (solar and terrestrial), and ozone concentration. Author

N65-30053# European Co. for the Chemical Processing of Irradiated Fuels, Mol (Belgium).
TESTS ON A p-n JUNCTION SEMICONDUCTOR RADIATION DETECTOR AND A LOW NOISE AMPLIFIER SYSTEM
M. De Carolis, G. Hannestad, and L. Svansson Sep. 1964 23 p refs
(NP-14875; ETR-168)

A series of measurements has been taken on two surface barrier semiconductor detectors, a charge sensitive preamplifier and on a low noise amplifier assembly. The purpose of these tests was to know the efficiency of all the equipment, the difference existing between two detectors of different resistivity and to investigate the optimum conditions for the electronic equipment. A short summary is given on how a semiconductor detector works with its amplifier system. Author

N65-30072# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
TESTING AND FURTHER DEVELOPMENT OF AN ELECTRONIC CLOUD DETECTOR Final Report
Lothar H. Ruhnke 20 Oct. 1964 58 p refs
(Contract AF 19(628)-3894)
(AFCRL-64-869; AD-616349)

An electrostatic sensor for use on weather radiosonde has been designed to detect boundaries of stratified clouds. A vertical dipole antenna senses the displacement current due to the vertical velocity of the balloon and the change of the atmospheric electric field at cloud boundaries. The electronic circuitry consists of a solid-state electrometer with 10^{10}-ohm input resistance acting as a voltage-resistance transducer. The circuit is simple and inexpensive; it contains no batteries or components with limited shelf life. A manned hot-air balloon was employed several times to correlate visual and electrical observations. Turbulence in clear air produces electric field fluctuations which, to a minor degree, affect the recordings. Of concern also were undulation movements of neoprene balloons with short leader lines. Flight results show good agreement with visual observations and Weather Bureau reports. Author

N65-30085# Royal Aircraft Establishment, Farnborough (England).
THE PERFORMANCE OF A NUMBER OF PHOTOGRAPHIC MATERIALS WHEN USED FOR STAR TRAIL PHOTOGRAPHY
C. W. Husbands London, Min. of Aviation, Mar. 1961 16 p refs
(RAE-TN-TD-59)

A method and apparatus for investigating the performance of photographic materials for star trail photography are described and the results obtained from a number of emulsions are given. Author

N65-30086# Royal Aircraft Establishment, Farnborough (England).
THE PERFORMANCE OF SOME AIR CAMERA LENSES WHEN USED FOR STAR PHOTOGRAPHY
C. W. Husbands and P. Benger London, Min. of Aviation, May 1961 13 p ref
(RAE-TN-TD-60)

A method is described for testing the suitability of lenses for star trail photography. Test results for a number of air camera lenses are given, and these results are discussed in relation to the theoretical performance of the lenses. Author

N65-30091# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TURBO-FLOWMETER FOR AUTOMATIC CONTROL OF A MASSIVE DISCHARGE
G. P. Katys, V. V. Blazhnevskiy et al 6 Jul. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 165321 (Appl. No. 787475/26-10, 14 Jul. 1962) 2 p
(FTD-TT-65-771/1+2+4; AD-617654)

A turbo-flow meter for automatic control of massive discharge is proposed to enable the measurement of small masses of discharge of multiphase flows over a broad range of viscosity changes. The principle and layout of the flow meter, which is based on measurement of the moment of Coriolis force arising on a sensitive element, is illustrated. M.W.R.

N65-30100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTRUMENT FOR MEASURING THE SPEED OF ULTRASOUND
S. K. Germanov and Sh. I. Shchitnikov 21 May 1965 7 p Transl. into ENGLISH from Russian Patent no. 153145 (Appl. no. 753513/26-10, 28 Nov. 1961 3 p
(FTD-TT-65-467/1+2; AD-617668)

An instrument, which eliminates ambiguity when measuring over a wide range of ultrasound velocities, is described. Based on the phase method, the circuit for measuring phase shift in the carrier frequency is supplemented with a circuit for measuring the phase shift of the modulating frequency. The device makes it possible to increase resolving power and extend measurement limits. C.T.C.

N65-30107# Bendix Corp., Southfield, Mich. Research Labs.
AUTOMATED ANALYTICAL STEREOPLOTTER Second Technical Documentary Report, 1 Nov. 1963–30 Jun. 1964
Walter E. Chapelle Griffiss AFB, N. Y., RADC, Jun. 1965 51 p *Its* Rept.-2693
(Contract AF 30(602)-2942)
(RADC-TDR-64-405; AD-617762)

This report describes the development of an automated version of an AS-11A analytical stereoplotter. The system utilizes electronic image correlation in conjunction with the AS-11A control computer to automatically produce contour and profile charts. The equipment accommodates frame or panoramic photography, either vertical or convergent. The maximum rates of contouring or profiling are 10 millimeters per second. Maximum terrain slope accommodated is 45 degrees. Capability is provided for automatic orientation of stereo-models and for visual monitoring during automatic operation. Author

N65-30108# Litton Systems, Inc., Canoga Park, Calif. Data Systems Div.
FACTORS AFFECTING RESOLUTION OF ELECTROSTATIC RECORDED AND TONER DEVELOPED IMAGES
Fred Smith Griffiss AFB, N. Y., RADC, Jun. 1965 127 p refs
(Contract AF 30(602)-3499)
(RADC-TR-65-47; AD-617780)

The report covers studies of the many factors which affect the resolution of an image formed by applying a plastic toner to an electrostatic image formed on a transparent film. Recommended improvements resulting from the studies have been incorporated in an experimental recorder. Measurement of the best resolution achieved was 230 line pairs per inch. The best optical density achieved on the transparent dielectric film was approximately 2 and 10 to 11 gray scale steps were discernible. Author

N65-30110# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
THE COMPENSATION OF TWO-BEAM INTERFEROMETERS
W. H. Steel Jun. 1965 25 p refs *Its* Instrumentation Papers No. 66
(AFCRL-65-382; AD-617255)

For a two-beam interferometer, the variations of intensity in the plane of observation are given by the modulation function, which is equal to the mutual coherence function for the radiation arriving by the two separate beams. When this function is expressed in its most general form, it is found to depend on the spatial and spectral distributions of the light from the source, on any differences in the optical paths followed by the two beams, and on the states of polarization of the two beams. Hence, an interferometer can be used to measure any one of these quantities provided its influence can be separated from that of other quantities. This separation of effects is basic to the techniques of interferometry and leads to the idea of compensation: the design of an interferometer that is insensitive to one or more of the quantities listed above. Examples are given of the compensation of interferometers for the spatial and spectral properties of the source and also for the state of polarization of the light. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-29166# Raytheon Co., Wayland, Mass.
ARSR QUINTUPLE ROTARY JOINT ASSEMBLY Final Report
Ray H. Hyde Jan. 1965 28 p
(Contract FA-WA-4524)
(SRDS-RD-65-29)

The ARSR Quintuple Rotary Joint provides a rotary joint assembly with sufficient capacity to allow the operation of radar beacon equipment using the center marking technique with the ARSR family of radars. The five channels provide two L-band joints for the ARSR: one for main radar and one for sidelobe cancellation; and three L-band joints for the ATCRBS beacon: one for normal beacon, one for center marking, and one for sidelobe cancellation. The design allows for the future incorporation of additional low and medium power joints as the FAA requirements grow. The rotary joint assembly is completely, simply, and continuously interchangeable between the ARSR-1A and 1C type pedestal and the ARSR-2 type pedestal. An ARSR-1 type trial installation was both mechanically and electrically made with complete success. The environmental tests were successfully made with the Quintuple Rotary Joint Assembly installed in an ARSR-2 pedestal proving both mechanical and electrical compliance with the specification in this type of antenna pedestal. Author

N65-29186# Hughes Aircraft Co., Culver City, Calif.
RIGIDIZATION TECHNIQUES FOR INTEGRALLY WOVEN COMPOSITE CONSTRUCTIONS Technical Documentary Report, Jul. 1963–Jul. 1964
L. B. Keller and S. Schwartz Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 79 p refs
(Contract AF 33(657)-11287)
(ML-TDR-64-299; AD-615600)

This report describes the investigation of methods to erect and rigidize three-dimensional woven fiberglass sandwich under space conditions; and to determine the physical properties of the rigidized sandwich material. The investigation included both triangular and rectangular fluted woven sandwich in weights from 12 to 23 ounce per square yard. Impregnating or rigidizing materials and processes included gelatin rigidized by solvent loss, gas catalyzed polyurethane, ultraviolet activated polyesters, and heat activated single component polyurethane foam powder. Methods for impregnating, storing, and automatically erecting and rigidizing the sandwich materials were developed successfully for all of the chemical rigidizing systems. Density of the space rigidized materials varied from 2 to 8 pounds per cubic foot depending on system, weight of cloth, and resin content. Strengths obtained were of the same order of magnitude as other conventional lightweight structural materials. Author

N65-29203# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MANUFACTURING FILAMENT-WOUND CONICAL SHELLS OF IMPREGNATED GLASS
Ye. G. Makharinskiy, S. L. Roginskiy, V. I. Korobov, G. S. Kruglov, and A. A. Peshekhonov 29 Apr. 1965 4 p refs
(FTD-TT-64-1295/1+2; AD-615254)

A device for filament winding of conical shells made of impregnated glass materials is described. The device contains a revolving conical mounting and a movable bobbin holder with a heating roller which prevents the wound filament from slipping on the mounting. Spring mounted rollers are divided along the axis into freely turning sections. The generatrix of the rollers corresponds to the profile of the shaping conical mounting. R.N.A.

N65-29233# United Kingdom Atomic Energy Authority, Harwell (England). Theoretical Physics Div.
A WORKSHOP SCHEDULING PROCEDURE
T. A. J. Nicholson Mar. 1965 30 p refs
(AERE-M-1568) HMSO: 4s

A procedure is described to schedule jobs through a workshop. Each of the jobs consists of a specified sequence of operations, and the procedure is designed to order these operations through the machines efficiently in terms of a management objective. The usual objective is to complete the work in the minimum time, but in this paper three objectives are distinguished. The procedure does not necessarily provide an optimal scheduling, but it should be near optimal. It is essentially simple and easy to implement. Author

N65-29235# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
COMPONENT RELIABILITY PREDICTION
C. M. Ryerson Jun. 1965 48 p refs
(TM-828)

A reexamination of the categorization of stress and strength factors so as to provide an improved rationale for prediction based on realistic mathematical models is proposed. A set of mathematical models formulated in the form of prediction equations for specific components, taking into account those environmental and operational factors which exert an influence upon the basic failure rates are discussed. The initial equations are to reflect the theoretical and intuitive considerations derived over a period of years by experienced reliability engineers. Failure rate theory, inter-action factors, and factors for improved prediction are included. E.E.B.

N65-29259# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRECISION CASTING. PRODUCTION OF PRECISION CASTINGS BY INVESTMENT MOLDING
Josef Doskar and Otakar Kastanek 31 Mar. 1965 157 p refs Transl. into ENGLISH of the book "Presne Liti (Vyroba Presnych Odlitku Metodou Vytavitelneho Modelu)" Prague, Statni Nakladatelstvi Tech. Lit., 1961 p 1–149
(FTD-TT-64-1022/1+2+3+4; AD-465417)

Production of precision castings by the investment pattern method is discussed from technical and practical viewpoints to provide data for foundrymen and others requiring information about the applicability of investment casting. Characteristics of the investment pattern method are discussed in terms of the operation itself, accuracy of casting dimensions, surface roughness, weight reduction of parts, use of special alloys, and weight and material composition of castings. Procedures for manufacturing and assembling patterns are included, and pattern sets for various types of castings are discussed. Manufacture of ceramic molds by various techniques is compared. Also discussed are the finishing operations, defects, and inspection of castings, as well as precision casting foundries and their equipment. Sections on economy and safety are included. M.W.R.

N65-29643# Royal Aircraft Establishment, Farnborough (England).
THE REDUCTION OF FRICTION IN PISTON TYPE HYDRAULIC SERVO VALVES
A. G. Earl London, Min. of Supply, May 1954 14 p refs
(RAE-TN-GW-312)

This note describes experiments that have been made to investigate the effectiveness of two methods of reducing friction in piston type hydraulic servo valves. The methods tried were very fine filtration of the oil supply and tapering the sealing lands of the servo piston. The first of these gave a reduction in valve friction of about 80% and the second method a reduction of about 60%. A combination of the two resulted in a decrease in friction of over 90%. Author

N65-29708# Aerojet-General Corp., Sacramento, Calif.
HYDROSTATIC BEARING FEASIBILITY PROGRAM Quarterly Progress Report, 1 Jan.–31 Mar. 1965
7 Jun. 1965 64 p ref
(Contract AF 04(611)-7439)
(Rept.-7439-Q-3; AD-616284)

Initial acceptance testing of the electric drive, five journal bearing oil tests (laminar flow), and eight journal bearing water tests (turbulent flow) were conducted. The condition of the bearings after testing and the correlation of test results with the applicable laminar theory and newly developed turbulent flow theory was excellent. The close correlation of the empirical and predicted data substantiates the validity of the turbulent flow theory to the point where only minor adjustments are needed to further improve the degree of correlation. The difficulties encountered with the electric drive appear to be correctable, unless the drive should fail to develop sufficient shaft output power at both 20000 and 30000 rpm shaft speed. The maximum rotational speed achieved was 18600 rpm on the 4.5-inch diameter journal bearing. The maximum bearing load with shaft rotation was 15000 lb which occurred during the tests with water. E.E.B.

N65-29729*# National Aeronautics and Space Administration, Washington, D. C.
STATE OF THE ART OF THE THEORY AND ANALYTICAL DESIGN METHODS FOR VORTEX PUMPS [SOVREMENNOYE SOSTOYANIYE TEORII I METODOV RASCHETA VIKREVYKH NASOSOV]
N. N. Kupryashin and V. G. Kovalenko Jul. 1965 28 p refs Transl. into ENGLISH from Vestn. Mashinostr. (Moscow), no. 4, 1957 p 20–28
(NASA-TT-F-9466) CFSTI: HC $2.00/MF $0.50 CSCL 13K

Vortex (turbine, regenerative, periphery) pumps and centrifugal-vortex pumps are reviewed, accounting in greater detail than formerly for such factors as head, capacity, and efficiency requirements, impeller blading, outer channel cross section configuration, leakage and other losses, recirculation, shaft r.p.m., etc. Analytical and experimental characteristic curves are given for specific Soviet models, with fair consistency between the two. High efficiencies are obtained using an open impeller with 24 back-curved blades and a rectangular channel (43%), or a closed impeller with semicircular passage and 24 to 32 forward-curved blades (50%). The theory presented herein is adequate for an analytical determination of the mean vortex velocity and ultimately for derivation of a fundamental equation of the vortex pump. Author

N65-29730*# National Aeronautics and Space Administration, Washington, D. C.
MODERN VORTEX AND CENTRIFUGAL-VORTEX PUMP CONSTRUCTION [SOVREMENNYYE KONSTRUKTSII VIKHREVYKH I TSENTROBEZHNO-VIKHREVYKH NASOSOV]
V. G. Kovalenko and N. N. Kupryashin Jul. 1965 18 p refs Transl. into ENGLISH from Vestn. Mashinostr. (Moscow), no. 2, 1958 p 10–16
(NASA-TT-F-9467) CFSTI: HC $1.00/MF $0.50 CSCL 13K

The performance characteristics and constructional details of Soviet-made vortex and multistage centrifugal-vortex pumps, classified as open- and closed-passage types, are described, with numerous examples of specific commercial and experimental models. Some of the means incorporated for reducing the size and weight of such pumps, decreasing cavitation, economically introducing self-priming, and for enhancing pump efficiency are discussed, including the use of shrouds, series and parallel connection between stages, cantilever-type impellers, curvature of the impeller blades, configuration of the flow-through channel, use of a single impeller to serve different stages, multiple suction and discharge openings, etc. Author

N65-29743*# Hittman Associates, Inc., Baltimore, Md.
THERMOELECTRIC BONDING STUDY Progress Report No. 8, 1–31 Mar. 1965
[1965] 2 p
(Contract NAS5-3973)
(NASA-CR-64023) CFSTI: HC $1.00/MF $0.50 CSCL 09A

Efforts during the report period have been concentrated on the thermoelectric element test fixture. Preliminary design and

layout drawings of the test system have been completed. The system will consist of four individually controlled inert atmosphere chambers, each capable of testing six thermoelectric elements at hot temperatures up to 1000° F and cold junction near room temperature. Provisions have been made for measuring hot and cold junction temperatures, voltage and power output, and element resistance. Extension of the previously developed braze process to PbSnTe material and to the brazing of samples of diameter other than one-half inch has been undertaken. N.E.A.

N65-29745*# IIT Research Inst., Chicago, Ill. Technology Center.
INVESTIGATION OF RANDOM THICKNESS VARIATIONS IN CHEM-MILLED 2219-T37 ALUMINUM Final Report
Howard T. Francis 29 Apr. 1965 52 p refs
(Contract NAS8-11444)
(NASA-CR-64047; IITRI-B6031-5) CFSTI: HC $3.00/MF $0.50 CSCL 13H

A study has been made of random thickness variations in chem-milled, aluminum alloy. A method was devised to simulate the production problem, employing a nonuniformly quenched bar specimen. In these specimens, the slower cooled zone is attacked more rapidly and develops a negligible amount of "smut" during chem-milling. The water-quenched zone is more slowly and nonuniformly milled, and develops a heavy and nonuniform-adherent smut. It is concluded that the slower attack is probably due to the shielding action of the smut deposit, and that the nonuniform attack results from the variations in smut retention. Copper complexing additives (mostly amines) were screened for possible corrective action in the milling process; none was entirely satisfactory. An approach to the problem is suggested in which a deliberately heavy and uniform smut is generated during milling, thereby inducing a uniform milling rate in spite of metallurgical variations. Author

N65-29747*# Hittmann Associates, Inc., Baltimore, Md.
THERMOELECTRIC BONDING STUDY Quarterly Progress Report, 1 Mar.–31 May 1965
30 Jun. 1965 10 p ref
(Contract NAS5-3973)
(NASA-CR-64017; HIT-170) CFSTI: HC $1.00/MF $0.50 CSCL 13H

In order to optimize the bonding of lead telluride thermoelectric elements to iron with tin telluride or titanium modified tin telluride braze, an apparatus is being constructed to test individual PbTe thermoelectric elements. The test system is designed to measure the hot junction and cold junction temperatures, output voltage, power output, and element resistance of each element under operating conditions for periods from 100 to 5000 hours. A hot pressing fabrication process for PbSnTe and n-PbTe elements is described. Room temperature electrical resistivity and Seebeck coefficient at 100° to 200° C were measured on all elements; the n-PbTe samples generally conformed to within 10% of the published values. A tin soldering process for attaching cold shoes to thermoelectric elements has been investigated. A description of the brazing process, and a method for preparation of the materials used in joining iron hot shoes to PbTe and PbSnTe is given. M.R.W.

N65-29749*# Stanford Univ., Calif. Dept. of Materials Science.
MECHANISMS OF STRENGTHENING AND FRACTURE IN COMPOSITE MATERIALS Second Progress Report, Dec. 1, 1964–May 31, 1965
A. S. Tetelman [1965] 15 p
(Contract NsG-622)
(NASA-CR-64011) CFSTI: HC $1.00/MF $0.50 CSCL 13H

This report describes research activities that were performed during the second phase of a program designed to investigate the mechanism of strengthening and fracture of composite materials. Three different types of composites are currently being investigated. These are discussed separately in the following areas: (1) the mechanism of strengthening and fracture in composites containing hard particles dispersed in a soft matrix; (2) the initiation of fracture in a composite material containing a pre-induced crack; and (3) the mechanism of fracture in composites in mechanically drilled holes and a B.C.C. matrix. N.E.A.

N65-29779*# Hittmann Associates, Inc., Baltimore, Md.
THERMOELECTRIC BONDING STUDY Monthly Progress Report No. 9, 1–30 Apr. 1965
[1965] 2 p
(Contract NAS5-3973)
(NASA-CR-64034) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Activities in a thermoelectric bonding study are reported. A thermoelectric element test fixture design was completed. Approximately 100 p-type PbSnTe elements were fabricated for property evaluation and for use in braze process optimization. Satisfactory correlation with property values was obtained. Results indicate that the bonding process developed for p-PbTe is not completely satisfactory for p-PbSnTe. The braze cycle is being modified to obtain bonds comparable to those made with the p-PbTe material. R.N.A.

N65-29789# Rocketdyne, Canoga Park, Calif. Liquid Rocket Div.
ROCKETDYNE QUALITY PROGRAM PLAN
12 May 1965 76 p Supersedes R-3760-2; R-3759-2 (R-6158-1; R-3760-2; R-3759-2)

A quality assurance plan for Rocketdyne performance under applicable NASA prime or major subcontracts for propulsion systems is presented. Statements of policies and objectives, a description of the operating plan, and a definition of operating functions and systems for accomplishing the plan are included. The Liquid Rocket Division Canoga/Neosho Quality Control Manuals and Field Laboratories Test Quality Control Manual parallel by section title and content the requirements of this Quality Program Plan. Through these manuals, the requirements of the Program Plan are detailed and effectively translated into operating practice. Author

N65-29830 General Motors Corp., Indianapolis, Ind. Allison Div.
ON THE STRUCTURE OF HIGHER LEVEL LANGUAGES FOR AUTOMATIC DRAFTING
W. J. Elliott and R. C. Hood *In its* Allison Res. and Eng. Quart. 1965 p 9–29 refs (See N65-29828 18-34)

A two-dimensional numerically controlled engineering drafting machine, and the language structure designed for the machine are discussed. The machine is a continuous path contouring device capable of drawing straight lines only. Conic sections and continuous algebraic or transcendental functions are drawn by approximating the desired function with a series of chords whose deviation from the actual function may be as small as 0.001 inch. Drawing can take place on ordinary paper, mylar, cloth, or metal. The manner in which the tool moves in the two-dimensional space is a function of coded information made available to the drawing system on a punched paper tape medium. The machine permits drawing at a maximum rate of up to 280 inches per minute while holding accuracy to ±0.005 inch overall on the 5 ft x 12 ft drawing surface. The structure, control, drawing operations, characteristics, notation

and coding for the language are detailed; and the nature of the language translator is discussed. L.S.

N65-29845*# National Aeronautics and Space Administration, Washington, D. C.
LUBRICATION, CORROSION AND WEAR A Continuing Bibliography, Jan. 1962–Mar. 1965
[1965] 167 p refs
(NASA-SP-7020) CFSTI: HC $1.75/MF $1.00 CSCL 11H

An annotated bibliography is presented on lubrication, corrosion, and wear. Included are topics such as lubricating systems, design and performance of bearings, special applications of lubricants, stress corrosion and fatigue cracking in metals and alloys, friction and wear characteristics of materials, and types of corrosion and techniques for corrosion prevention. A few references describing the instrumentation and methods of testing lubricants are also included. R.N.A.

N65-29887# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TO DETERMINE RESERVES FOR SYSTEMS OF REPEATED ACTION
A. D. Solov'yev 12 May 1965 11 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSR, Otd. Tekhn. Nauk: Energ. i Avtom. (Moscow), no. 2, 1962 p 124–129
(FTD-TT-65-13/1; AD-617097)

A method is described which determines the number of spare instruments necessary for satisfactory operation of a group of n identical instruments for a long period of time. The results of this investigation can be applied to evaluation of the reliability of a computer system. Author

N65-29919# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPECIAL CASTING TECHNIQUES (CHAPTER 9)
N. P. Dubinin 5 May 1965 171 p refs Transl. into ENGLISH of the book "Spravochnik Dlya Masterov Liteynogo Proizvodstva" Moscow, Gos. Nauchno Tekhn. Izd. Mashinostr. Lit., 1961 p 564–752
(FTD-TT-64-1047/1+2; AD-617100)

Special casting techniques are progressive production methods. These casting techniques include the following: metal mold casting (chill mold casting), shell-mold casting, investment casting, centrifugal casting, and others. Each of these methods of casting has its own field of application, in which it is profitable. The basic advantage of the special casting techniques is that they produce castings of higher precision, so that the machining allowances can be reduced. TAB

N65-29938# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
FIRST PROGRESS REPORT BY THE MATERIALS ADVISORY BOARD AD HOC COMMITTEE ON METAL-WORKING PROCESSES AND EQUIPMENT
15 Mar. 1965 32 p refs
(Contract ARPA SD-118)
(MAB-206-M)

The government Metalworking Processes and Equipment Program is a cooperative effort of the Military Services and National Aeronautics and Space Administration to support studies of deformation theory which will lead to the improvement of manufacturing technology. At the request of the Department of Defense the Materials Advisory Board Committee on Metalworking Processes and Equipment is assisting in the planning and technical phases of the program. The Committee has assessed the potential of vibrational energy technology and hydrostatic extrusion which were the subjects of recent government-sponsored symposia, and have submitted conclusions and recommendations as to the value and limitations of these processes and the manner in which the development of each should be undertaken. Author

N65-29941# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF THE WEAR AND FRICTION CHARACTERISTICS OF A HIGH TEMPERATURE SOLID FILM LUBRICANT IN HIGH VACUUM AND IN AIR
Donald W. Flage (M.S. Thesis) 1964 128 p refs

With a specially designed machine, the wear and friction characteristics of high temperature SFL #1000 were investigated. The lower wear specimen, coated at the factory to a thickness of 0.0003 to 0.0005 in., was the rotating member. The upper non-rotating specimen, identical to the lower, was uncoated. These mating wear and friction annular surfaces were tested under controlled variables. The SFL #1000 ceramic bonded high temperature solid film lubricant was found to have: (1) unacceptably high dynamic coefficient of friction in high vacuum as well as in air. Typical values ranged from 0.30 to 0.40; (2) undesirable stick-slip phenomenon, occurring when the static friction coefficient exceeds the dynamic coefficient; (3) excessively high wear rates (typical rates ranged from 10 to 50μin./min.); and (4) low lives. Film failure occurred usually between 1 and 10 minutes. The results of these tests clearly indicated that this lubricant would make a poor candidate for any practical engineering application where moderate speed and running time were needed. N.E.A.

N65-29944# Naval Postgraduate School, Monterey, Calif.
THE THEORY AND CONSTRUCTION OF A LIQUID HELIUM CRYOGENIC PUMP
George M. La Chance (M.S. Thesis) 1964 55 p refs

Cryogenic pumping is a means of maintaining a high vacuum with large gas in-leakage rates. This is accomplished by the condensation and freezing of the gas molecules onto a surface that is maintained at a temperature well below the freezing point of the gas. A liquid helium filled "batch process" cryogenic pumping system was constructed and instrumented. The vacuum chamber and roughing system were obtained by the modification and redesign of an existing vacuum furnace. The theory of cryogenic pumping is presented and an approach developed for the evaluation of the cryopump performance. Author

N65-30089# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MASS OF A SHAFT AND ITS EFFECT ON THE CRITICAL ANGULAR VELOCITIES OF TURBINE ROTOR
K. A. Kryukov 12 May 1965 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 4, 1958 p 101–108
(FTD-TT-64-1054/1+2; AD-617661)

A frequency equation is derived for a system with a weighty shaft to find the effects of shaft mass on the critical angular velocities of a turbine rotor. A graphic solution is presented for the equation. Examples are given to show the method of determining eigenfrequencies of a turbine rotor of a nonrotating shaft and for the case of straight synchronous precession. M.W.R.

N65-30137# Curtiss-Wright Corp., Caldwell, N. J. Curtiss Div.
RESEARCH ON ACCELERATED RELIABILITY TESTING METHODS APPLICABLE TO NON-ELECTRONIC COMPONENTS OF FLIGHT CONTROL SYSTEMS Final Report, May 1, 1963–May 1, 1964

W. F. Johnson, Jr. et al Wright-Patterson AFB, Ohio. AF Flight Dyn. Lab., Mar. 1965 199 p refs
(Contract AF 33(657)-11080)
(AFFDL-TR-64-181; AD-617567)

This study is concerned with the development of techniques for the testing of electromechanical components in time compressed form. The motivating basis for this work is that presently used statistical testing methods require large numbers of samples and long testing periods to compile meaningful MTBF data. The approach employed herein included: System failure mode analysis; Classification and ranking of failure modes in terms of influence and frequency of occurrence; Physics of failure analysis at part and material levels. "Measured weakening" (pre-cracking) technique was developed and applied to the most predominate failure parts to generate failures in reasonably short test times. In addition, extraneous or unwanted failures were not produced, which is frequently the case when "over load" testing is employed. An all mechanical position servo unit was selected as a typical energy conversion flight control system component on which tests were conducted to verify the developed techniques for accelerating reliability testing. The tests results indicated that "measured weakening" of mechanical parts can be employed to reduce the number of samples required and the test time involved to perform reliability testing. Author

N65-30168# General Dynamics/Astronautics, San Diego, Calif.
INVESTIGATION OF BOND DETERIORATION BY USE OF THE FOKKER BOND TESTER
J. Hertz 31 Dec. 1964 26 p refs
(GD/A-ERR-AN-682)

A Fokker Bond Tester was used in an attempt to determine bond deterioration non-destructively. Bonds exposed to salt spray, boiling water, 100 hours at 500° F, high vacuum (5×10^{-6}), gaseous fluorine, liquid fluorine and FLOX (30% F_2 and 70% O_2) were evaluated nondestructively as well as destructively. The Fokker indicated slight deterioration in some bonds but was unable to predict actual reduction in strength. Author

N65-30186*# Sea-Space Systems, Inc., Torrance, Calif.
ULTRA THIN GAUGE POLYMERIC FILMS FOR SPACE APPLICATIONS
Dale W. Cox, Jr. Washington, NASA, Aug. 1965 47 p refs
(Contract NAS7-274)
(NASA-CR-274) CFSTI: HC $2.00/MF $0.50 CSCL 13H

Experimental resins and a vertical, blown film process, including a conventional long barrel extruder, variable orifice die, and high tower takeup were used to extrude layflat tubular polyethylene film in gauges down to 1/16.3 mil. In this process, molecular orientation was achieved in both the machine and transverse directions, the relative degree depending primarily on the die opening to film gauge ratio and the blow-up ratio. The results were films with approximately balanced strengths in both directions, with good physical properties and sealability. The ultimate tensile strength of the film was 7500 psi, an increase of almost 300% over conventional gauge film from the same resin. C.T.C.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-29390*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
LINE WIDTH AND INVERSION RATIO OF IRON-DOPED RUTILE
C. Curtis Johnson and Larry E. Rouzer [1964] 5 p ref Submitted for Publication
(NASA-TM-X-54754) CFSTI: HC $1.00/MF $0.50 CSCL 20E

Experimental studies of the line width and inversion ratios of iron-doped rutile (Fe^{3}-TiO_2) are reported which demonstrate the usefulness of this material for broadband maser applications. Optimum concentration studies resulted in measured line widths of 60-Mc and inversion ratios in excess of 15:1. Inversion ratios were also calculated from the gain and paramagnetic absorption data taken over the frequency band of 2.9–4.1 gc. Inversion ratios averaged better than 15:1 over the entire band. Net gains of 20-db per inch were attained with this material. The rutile was loaded on a meander line using a conventional loading technique. Sufficient isolation was incorporated into the structure to make the amplifier gain stable and eliminate regeneration. All measurements were taken at liquid helium temperatures. Among the primary advantages found in the use of iron-doped rutile was the substantial reduction in the required magnetic field strength. S.C.W.

N65-29444*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE APPLICATION OF MASERS TO PHYSICAL MEASUREMENTS
Walter H. Higa [1964] 3 p refs Presented at the Intern. Conf. of Microwaves, Circuit Theory and Inform., Tokyo, 7–11 Sep. 1964
(Contract NAS7-100)
(NASA-CR-58815) CFSTI: HC $1.00/MF $0.50 CSCL 20E

The use of masers as low noise preamplifiers in microwave communications is well known. This paper describes the use of masers in physical measurements. In particular, the changes in spin-temperature of a paramagnetic crystal as a function of various perturbations have been measured. Both spin "heating" and spin "refrigeration" of the order of 1° K have been measured, at a crystal temperature of 4.2° K, by perturbing the Boltzmann distribution in a multi-level spin system. Details of the experimental arrangement will be given with the results obtained. Author

N65-29794# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
APPLICATIONS OF LASERS TO PHOTOELASTICITY
C. E. Taylor, C. E. Bowman, W. P. North, and W. F. Swinson Mar. 1965 21 p refs
(TEAM-276)

This paper discusses briefly the principles of gaseous and ruby lasers and makes comparisons of pertinent properties of lasers and conventional light sources. Since the output from a laser is a highly collimated beam of monochromatic light that can be made extremely intense and plane polarized, the eminent suitability of lasers as light sources for photoelasticity is suggested. Lasers are shown to be superior to conventional light sources, especially for the scattered light method and for high speed dynamic work. Experiments are described and results are given for using lasers for (1) the scattered light method, (2) a conventional transmission polariscope with static loads, and (3) dynamic photoelasticity. Author

N65-29901# American Optical Co., Southbridge, Mass. Research Center.
EXPERIMENTAL VERIFICATION OF SUN-POWERED LASER TRANSMITTER Interim Engineering Report, Apr.–Aug. 1962
D. A. La Marre [1962] 43 p refs
(Contract AF 33(657)-8619)
(IER-1; AD-437865)

A program of experimentation and design leading to the delivery of an experimental model of a sun-powered laser transmitter is described. Efforts to achieve sun-powered laser action using ruby, a three-level laser material are reviewed. Possible causes of the discrepancy between theoretical predictions and the unsuccessful experimental results of an earlier program are discussed. The feasibility of using four-level laser materials is investigated. A general expression is derived for the figure of merit "G" of a four-level laser in the sun-powered end-pumped configuration. In a survey of possible new laser materials, two four-level types, neodymium-doped calcium tungstate (Nd^{3+}:$CaWO_4$) and neodymium-doped glass, (Nd^{3+}:glass) were determined to be promising. Calculation of "G" indicates that Nd^{3+}:$CaWO_4$ should laser in the sun-powered end-pumped configuration, providing the loss coefficient of the sample is not large. Thermal problems involved in cooling neodymium-doped glass are analyzed. Experimental study of samples of ruby and Nd^{3+}:$CaWO_4$ to determine important laser parameters and optical quality is reported. Also, the status of the design and construction of the sun-tracking laser mount is specified. Author

N65-29906# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
PARAMETRIC EXCITATION OF ACOUSTIC WAVES IN SIMULATED BRILLOUIN SCATTERING
W. T. Kavage 1 Jun. 1965 31 p refs
(Contract AF 33(615)-2287)
(Rept.-1935-5; AD-466177)

Stimulated Brillouin scattering is a traveling wave parametric interaction between an acoustic wave and light. There are three types of stimulated Brillouin scattering and in this thesis the basic concept of these interactions is discussed. Experimental evidence for the backward traveling acoustic wave case is presented. The existence of a threshold power density for this case is shown. The appearance of "boundary effects" and the disagreement of experimental results with the existing theories is presented. Author

N65-30159# Varian Associates, Beverly, Mass.
HYDROGEN MASER PROGRAM Interim Technical Report, 1 Jul. 1963–27 Mar. 1964
Jacques Vanier 10 Jun. 1965 40p refs
(Contract Nonr-3570(00))
(AD-617342)

Research was conducted to determine the characteristics of the storage bulb of the hydrogen maser as part of a program for advancing the art of the hydrogen maser. Particular attention is given to wall relaxation, wall shift, exchange interactions, and maser tuning techniques. R.N.A.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-29161# Columbia Univ., New York. Dept. of Civil Engineering.
EXTENSION OF COPPER AND BRASS UNDER TENSION AND CYCLIC TORSION
W. A. Wood and W. H. Reimann Apr. 1965 32 p refs
(Contract Nonr-266(91))
(TR-18; AD-465537)

A study is made of the axial creep in copper and brass at various temperatures under steady axial tension and cyclic transverse torsion. One object was to find why some metals like copper exhibit creep that resembles high-temperature creep in showing primary, secondary, and tertiary stages while other metals like brass show transient creep only. It is shown that the difference arises because of differences in fatigue processes induced by the cyclic strain. Another object was to determine how the metals hardened during creep in the axial and transverse directions. It is found that in the axial direction hardening occurs progressively during creep and depends only on the extension, while in the transverse direction cyclic hardening at first increases and then approaches a steady value which coincides with cessation of the transient creep. It is pointed out that it is difficult to reconcile this hardening with dislocation theories that attribute the creep to recovery and that the creep is more in keeping with certain continuum-mechanics theories of irreversible second-order effects. Author

N65-29162# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIQUID METAL: A NEW WORKING FLUID
D. Stoenciu 24 May 1965 12 p Transl. into ENGLISH from Stiinta si Tehnica (Bucharest), no. 4, 1964 p 17–19
(FTD-TT-64-1234/1+2+3+4; AD-466195)

The results obtained by carrying out theoretical and experimental studies on the use of metal liquids as working fluids in hydraulic installations and automatic guidance and control systems with high and very high thermal regimes have shown that the production of such installations and systems requires the solution of some fairly difficult problems, such as choice of adequate materials, maintaining very small production tolerances, and others. At the same time, they have shown that present technology has the means to overcome these difficulties, and that in the near future such hydraulic installations and automatic guidance and control systems will be realized. N.E.A.

N65-29173*# New York Univ., N. Y.
EFFECT OF PRESSURE ON METALLURGICAL PHENOMENA Progress Report No. 10, Jan. 1–Jun. 30, 1965
[1965] 4 p
(Grant NsG-90-60)
(NASA-CR-63893) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The resistivity of thallium–lead alloys, containing up to 40 atomic percent lead, were studied as a function of temperature. The phase diagram consists of a eutectoid reaction at 180° C, with a eutectoid composition of 4.0 atomic percent lead. Isotherms of resistivity versus composition were drawn. Powder patterns taken at room temperature showed that the alpha form is stable up to about 2 atomic percent lead, and a two-phase mixture of alpha and gamma is stable between 2 and 12.5 atomic percent lead. The resistivity of tin–tellurium was measured at constant pressure as a function of temperature, and at constant temperature as a function of pressure. A new solid phase SnTe was found at high temperature and pressure. C.T.C.

N65-29197# Dayton Univ., Ohio. Research Inst.
THE EVALUATION OF HIGH TEMPERATURE MATERIALS Quarterly Progress Report, 1 Jan.–30 Mar. 1965

John C. Wurst, John A. Cherry, Dennis A. Gerdeman, and Norman L. Hecht 15 Apr. 1965 44 p refs
(Contract AF 33(615)-1312)
(QPR-5; AD-466894)

Progress on the program to evaluate coated refractory alloy sheets for structural applications is reported. The evaluation included metallographic analysis; bend transition temperature measurements; tensile strength measurements; cyclic oxidation tests in the range of 1600° to 3000° F with a failure rate analysis at 2600° F; and creep-rupture tests in a full factorial experiment. Photomicrographs and metallographic data for five TZM coating systems are presented. The completed cyclic oxidation tests on 20 mil coated TZM are summarized. All of the TZM coatings tested showed an increase in bend transition temperature. Tensile strength and elongation data are given for these tests. Based on the expansion data for three carbon bonded carbon cloth composites, the thermal expansion from 20° to 800° C was found to be 1.67×10^{-6} in./in./° C. At about 800° C the slope of the thermal expansion curve increased sharply with a resultant average coefficient of thermal expansion of 4.56×10^{-6} in./in./° C. E.E.B.

N65-29227# Atomics International, Canoga Park, Calif.
PREPARATION OF UC BY CARBOTHERMIC-REDUCTION OF U_3O_8
S. Strausberg 30 Jun. 1965 39 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10486) CFSTI: $2.00

A two step method was developed for the preparation of UC by carbothermic reduction of U_3O_8. The reactions are:

(1) $U_3O_8 + C \rightarrow 3UO_2 + CO_2$ (800 to 900° C)

(2) $UO_2 + 3C \rightarrow UC + 2CO$ (> 1300° C)

overall, $U_3O_8 + 10C \geq 3UC + 6CO + CO_2$.

Success of the process depends on complete reduction of U_3O_8 to UO_2 at the lower temperature. Studies of the gas evolved during the low temperature step showed small amounts of CO were produced. Also, about 10.22 moles of carbon are required for each mole of U_3O_8 to produce stoichiometric UC. The additional carbon is consumed in the formation of some CO during the low-temperature step. The preparation of kilogram quantities of hypostoichiometric UC presented some difficulties in oxygen removal. Temperatures of 1800 tp 1900° C are required to lower the oxygen content below 500 ppm and carbon pickup from the crucible and uranium metal vaporization change the product composition. However, it appears that UC suitable for recycle can be prepared by this method. Author

N65-29232# Pratt and Whitney Aircraft, Middletown, Conn.
UTILIZATION OF YTTRIUM IN GETTERING OXYGEN AND NITROGEN IN COLUMBIUM BASE MATERIALS
24 Jun. 1965 23 p refs
(Contract AT(30-1)-2789)
(PWAC-441) CFSTI: $2.00

Yttrium additions were made to a series of non-consumably arc melted columbium base materials to ascertain the efficiency of yttrium as a scavenging agent for refractory interstitial elements. A relationship was derived for the loss of oxygen as a function of yttrium loss. The influence of yttrium on the hardness and grain size of these materials is described. Author

N65-29240# Atomics International, Canoga Park, Calif.
THE PROPERTIES AND IRRADIATION BEHAVIOR OF U_3Si_2
H. Shimizu 25 Jul. 1965 46 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10621) CFSTI: $2.00

A limited study of the compound U_3Si_2 has been made in reference to its use as a prospective nuclear fuel in sodium cooled reactors. Pertinent physical and chemical data for the U-Si system were compiled or obtained and are reported. A 12-in. fuel column consisting of six each 10% enriched U_3Si_2 specimens, sodium bonded to a stainless steel cladding, was irradiated to an average burnup level of approximately 0.65% of the total uranium. The maximum average operating fuel centerline and surface temperatures were 1750° F and 1290° F, respectively. Except for the top specimen, which was cracked into several pieces, the irradiated fuel slugs were in relatively good condition. Fractional fission gas release of approximately 2.6% and representative density decreases of 6 to 7% were measured. The stainless steel cladding was intact and its microstructure appeared unaffected. Author

N65-29263# Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.
DEFORMATION PROCESSING OF ANISOTROPIC METALS Progress Report, 1 Jan.–30 Apr. 1965
D. H. Avery and W. A. Backofen Jun. 1965 35 p refs
(Contract NOw-65-0124-d)
(PR-4; PR-5; AD-465908)

A phenomenological explanation of superplasticity in metals has been based on the observation of a strong strain-rate dependence of flow stress, comparable to that of heated polymers and approaching that of hot glass. Experiments on some lead-tin alloys and composite specimens in which the structural size was manipulated through heavy mechanical working and various annealing treatments were carried out. It is suggested that when the characteristics of superplasticity appear, the transitional strain rate has been raised into the range of strain rates associated with conventional mechanical testing and some kinds of deformation processing. Author

N65-29284# Nuclear Metals, Inc., Concord, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. DEVELOPMENT OF ZIRCONIUM-BASE ALLOYS STRENGTHENED BY SLIS TECHNIQUES Summary Technical Report, 1 Jul. 1963–30 Jun. 1964
A. R. Kaufman and W. C. Muller 15 Jan. 1965 50 p
(Contract AT(30-1)-2784)
(NMI-1263)

A program was conducted to develop zirconium base alloys by the SLIS technique in which fine dispersions are achieved with metallic particles. Alloys of Zr–Be and Zr2–Be were prepared by dissolving the alloying element, beryllium, in liquid zirconium or Zircaloy 2 and rapidly quenching. Both alloys achieved the desired precipitate size and populace. Aging at 600° C produced a moderate increase in particle size. The alloys showed improvements in tensile strength and hardness over unalloyed zirconium and Zircaloy 2. Results demonstrate that it is possible to attain high temperature strength in zirconium by means of dispersion strengthened alloys prepared by the SLIS technique. Alloys of zirconium and Zircaloy 2 containing small additions of beryllium, when splatcooled, provide good stability in the 400° to 500° C range. R.N.A.

N65-29352# Joint Publications Research Service, Washington, D. C.
STUDIES IN CLAD TUBING AND THE MECHANICAL AND ELECTRICAL PROPERTIES OF ALUMINUM ALLOYS
13 Jul. 1965 17 p refs Transl. into ENGLISH of 3 articles from Tsvetn. Metal. (Moscow), no. 5, May 1965 p 73, 76–78, 82–85 refs
(JPRS-31078; TT-65-31576) CFSTI: $1.00

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1. COLD EXTRUSION OF CLAD TUBING M. S. Gil'dengorn p 1–5 refs (See N65-29353 18-17)

2. MECHANICAL PROPERTIES OF ALUMINUM ALLOY TUBING IN RELATION TO THE DEGREE OF DRAWING DEFORMATION G. N. Tityunik and V. Ya. Shapiro p 6–9 refs (See N65-29354 18-17)

3. EFFECT OF NIOBIUM, BERYLLIUM, AND CERIUM ON THE MECHANICAL PROPERTIES AND ELECTRICAL CONDUCTIVITY OF ALUMINUM Ya. M. Krupotkin and M. B. Gokhshteyn p 10–14 refs (See N65-29355 18-17)

N65-29353 Joint Publications Research Service, Washington, D. C.

COLD EXTRUSION OF CLAD TUBING

M. S. Gil'dengorn *In its* Studies in Clad Tubing and the Mech. and Elec. Properties of Aluminum Alloys 13 Jul. 1965 p 1–5 refs (See N65-29352 18-17) CFSTI: $1.00

A cold extrusion method of producing thin-walled tubes of aluminum alloys with internal and external cladding is considered. Cold extrusion of aluminum alloys and sintered aluminum powder was performed with specially-prepared bimetallic blanks fabricated by joint drawing of thick-walled metal base tubes with the cladding metal tubes as inserts. The great specific pressures and heating inherent in cold extrusion of bimetallic tubing creates favorable conditions for obtaining strong bonds between the metals. Cleaning the surfaces with wire brushes produces a hardening of the upper layer of the metal which is destroyed during deformation and exposes clean, unoxidized metal layers. During deformation there is a continuous renovation of the surfaces of the contacting metal which also enhances bonding. M.W.R.

N65-29354 Joint Publications Research Service, Washington, D. C.

MECHANICAL PROPERTIES OF ALUMINUM ALLOY TUBING IN RELATION TO THE DEGREE OF DRAWING DEFORMATION

G. N. Tityunik and V. Ya. Shapiro *In its* Studies in Clad Tubing and the Mech. and Elec. Properties of Aluminum Alloys 13 Jul. 1965 p 6–9 refs (See N65-29352 18-17) CFSTI: $1.00

The area of certain aluminum alloys was measured before and after drawing in a horizontal press with a force of 3500 tons. A self-adjusting arbor permitted the drawing of tubing 110 × 105 (2.5) mm with a force of 30 tons, and deformation was measured before and after drawing. It was found that for most of the alloys there is an increase in yield strength with increase in drawing, and this dependence was found to be similar to that obtained with sheet metal and wire. Alloys tested were designated as AMts, AMg, AMg_3, AMg_6, D1, and D16. M.W.R.

N65-29355 Joint Publications Research Service, Washington, D. C.

EFFECT OF NIOBIUM, BERYLLIUM, AND CERIUM ON THE MECHANICAL PROPERTIES AND ELECTRICAL CONDUCTIVITY OF ALUMINUM

Ya. M. Krupotkin and M. B. Gokhshteyn *In its* Studies in Clad Tubing and the Mech. and Elec. Properties of Aluminum Alloys 13 Jul. 1965 p 10–14 refs (See N65-29352 18-17) CFSTI: $1.00

In order to increase the strength of aluminum used in overhead electric power transmission lines without decreasing its electrical conductivity, small amounts of beryllium, cerium, and niobium were introduced into molten aluminum which was 99.995% pure. Smelting was performed in furnaces using graphite crucibles under a layer of flux with 75% calcium chloride and 25% cryolite. Each batch was cast into a water-cooled metal mold, machined, and then rolled into a wire of 1.96 mm diameter. Electrical resistivity increased for both the annealed and the cold-drawn wire as compared with the original high-purity aluminum. It was found, however, that niobium could not be used as an additive because its solubility in aluminum is very low, and its effect on strengthened resistivity is insignificant. With the addition of small amounts of Be, up to 0.5%, metal strength increased; addition of more Be, such as 1.1%, increased strength but decreased corrosion resistance. The addition of about 0.27% cerium increased both the strength and electrical conductivity of the aluminum wire and maintained high plasticity. M.W.R.

N65-29356# Joint Publications Research Service, Washington, D. C.

TITANIUM AND ITS ALLOYS

15 Jul. 1965 39 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 5, May 1965 p 15–21, 33–35, 45–50, 53–63
(JPRS-31091; TT-65-31589)

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1. INFLUENCE OF OXYGEN AND HYDROGEN ON THE MECHANICAL PROPERTIES OF ALLOYS VT1, OT4, AND VT15 M. A. Nikanorov and G. P. Dykova p 1–7 (See N65-29357 18-17)

2. AGING BETA-ALLOYS OF THE Ti–Mo–Cr–Fe–Al SYSTEM N. V. Ageyev, S. G. Glazunov, L. A. Petrova, G. N. Tarasenko, and L. P. Granova p 8–11 ref (See N65-29358 18-17)

3. THERMOMECHANICAL TREATMENT OF ALLOY VT15 S. G. Glazunov, A. I. Khorev, and E. V. Polyak p 12–16 (See N65-29359 18-17)

4. HEAT TREATMENT OF VT14, VT16 AND VT15 ALLOYS A. I. Khorev and L. V. Geras'kova p 17–20 ref (See N65-29360 18-17)

5. HARDENABILITY OF INDUSTRIAL TITANIUM ALLOYS L. P. Luzhnikov, V. M. Novikova, and A. P. Mareyev p 21–26 refs (See N65-29361 18-17)

6. HEAT TREATMENT OF CLAD VT15 ALLOY S. G. Glazunov and A. M. Legkodukh p 27–30 (See N65-29362 18-17)

7. EFFECT OF HEAT TREATMENT ON THE STRUCTURE AND PROPERTIES OF VT15 WELD JOINTS F. Ye. Tret'yakov, G. N. Kiryukhina, and A. I. Gorshkov p 31–36 refs (See N65-29363 18-17)

N65-29357 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF OXYGEN AND HYDROGEN ON THE MECHANICAL PROPERTIES OF ALLOYS VT1, OT4, AND VT15

M. A. Nikanorov and G. P. Dykova *In its* Titanium and Its Alloys 15 Jul. 1965 p 1–7 (See N65-29356 18-17) CFSTI: $2.00

The aim of this article is to investigate the joint effect of oxygen and hydrogen on the mechanical properties of certain alloys, in the initial state and while aging. The aging process that occurs in thermally nonhardenable alloys with hydrogen embrittlement leads to the formation of hydride phase, while in thermally hardenable alloys there occurs a disintegration of the solid solution and the formation of intermediate and excess phase. For the investigation, ingots of VT1, OT4, and VT15 alloys containing from 0.01 to 0.45 percent oxygen were smelted. After their forging, rods 16 mm in diameter were subjected to annealing in vacuum at 750° C, and saturation with hydrogen was carried out at the same temperature. Both the smooth and the notched specimens were tested mechanically

for tensile strength, impact toughness and hardness. The microstructures of the specimens were studied with the aid of optical and electron microscopes. N.E.A.

N65-29358 Joint Publications Research Service, Washington, D. C.
AGING BETA-ALLOYS OF THE Ti–Mo–Cr–Fe–Al SYSTEM
N. V. Ageyev, S. G. Glazunov, L. A. Petrovna, G. N. Tarasenko, and L. P. Granova *In its* Titanium and Its Alloys 15 Jul. 1965 p 8–11 ref (See N65-29356 18-17) CFSTI: $2.00

In order to determine the aging temperature at which the hardness and hence also the strength reached their maximum values, a study was made in the present work of the change in the structure and hardness of selected beta-alloys as a function of heating temperature in the range from 300° to 1000° C. It is shown that after quenching alloys of the system Ti–Mo–Cr–Fe–Al from high temperatures (1000° C), dislocations are observed in the beta-solid solution which are brought about by the action of the thermal stresses during the quenching process. In order to obtain maximum hardness, it is recommended to age beta-alloys at 500° to 550° C where a considerable alpha-phase is observed. N.E.A.

N65-29359 Joint Publications Research Service, Washington, D. C.
THERMOMECHANICAL TREATMENT OF ALLOY VT15
S. G. Glazunov, A. I. Khovrev, and E. V. Polyak *In its* Titanium and Its Alloys 15 Jul. 1965 p 12–16 (See N65-29356 18-17) CFSTI: $2.00

Regimes for TMT (thermomechanical treatment) were developed to improve the ductility while retaining the high strength of VT15 alloy. This was achieved by the HTTMT (high-temperature thermomechanical treatment) method: a combination of hot deformation (85%) from a single-phase beta-state at 1050° C and quenching in water, followed by aging at 480° C for 25 hours and at 560° C for 15 minutes. Preliminary work-hardening of the beta-solid solution following HTTM contributes to its uniform distribution during aging, and to a considerable comminution of the disintegration products, thereby improving the mechanical properties. N.E.A.

N65-29360 Joint Publications Research Service, Washington, D. C.
HEAT TREATMENT OF VT14, VT16 AND VT15 ALLOYS
A. I. Khorev and L. V. Geras'kova *In its* Titanium and Its Alloys 15 Jul. 1965 p 17–20 ref (See N65-29356 18-17) CFSTI: $2.00

The present work discusses the effect of heat treatment and cold plastic deformation on the mechanical properties of the titanium alloys. The investigated alloys were: VT14 (4% Al, 3.3% Mo, 0.05% Zr); VT16 (2% Al, 7.5% Mo); and VT15 (3% Al, 7% Mo, 11% Cr). Results from the investigation indicate that the insignificant increase in strength from cold plastic deformation of annealed and quenched VT14 and VT16 alloys is accompanied by a drastic reduction in ductility. This method of hardening semifinished and finished products made of these alloys is of no interest. The deformation of the annealed and quenched VT15 alloy increases its strength. The deformation of the VT16 and VT15 alloys following their hardening by heat treatment makes it possible to increase their strength. This method can be employed in production for semifinished and finished products of high strength. N.E.A.

N65-29361 Joint Publications Research Service, Washington, D. C.
HARDENABILITY OF INDUSTRIAL TITANIUM ALLOYS
L. P. Luzhnikov, V. M. Novikova, and A. P. Mareyev *In its* Titanium and Its Alloys 15 Jul. 1965 p 21–26 refs (See N65-29356 18-17) CFSTI: $2.00

The hardenability of titanium alloys was determined by the end-face method. The alloys used in the study included VT3-1, VT6, VT8, VT9, VT9-1, VT10, VT14, VT15, and VT16. Depending on the structure and phase composition, the examined alloys can be divided into three groups from the viewpoint of their hardenability: (1) alloys which become hardened by abrupt cooling into martensite, or with the formation of a two-phase mixture of $\alpha + \alpha'$ (with the α'-phase predominant); this pertains to the VT8, VT9, and VT9-1 alloys; (2) alloys hardened by abrupt cooling with the formation of a two phase mixture of $\alpha + \beta$-phases; in this case the β-phase has a supercritical concentration and becomes fixed at room temperature (VT3-1, VT6, VT14, and VT16); and (3) alloys in which the β-phase becomes fixed during quenching. In this case the degree of the stability of the β-phase depends on the extent to which the alloy is alloyed with β-stabilizers. This also determines the critical rate of quenching which is required for a fixed β-phase at room temperature (VT15). The VT10 alloy cannot be included in any of these groups. N.E.A.

N65-29362 Joint Publications Research Service, Washington, D. C.
HEAT TREATMENT OF CLAD VT15 ALLOY
S. G. Glazunov and A. M. Legkodukh *In its* Titanium and its Alloys 15 Jul. 1965 p 27–30 (See N65-29356 18-17) CFSTI: $2.00

The mechanical properties of clad VT15 alloy as a function of the heating temperature and cooling rates are investigated. A discussion is given on the dependence of hardness on the temperature and duration of aging of the alloy. Experiments were performed to select the conditions of heat treatment. The results indicate that the optimal heating temperature for hardening 3 mm thick sheets of VT15 alloy is 800° C. The cooling rate during hardening should not be less than 3 degrees per second. Owing to some passivating properties of the cladding layer, the rate phase transformation in the base metal is retarded. The sections of the metal located near the cladding layer are enriched with molybdenum and represent regions of non-decomposed beta-phase. N.E.A.

N65-29363 Joint Publications Research Service, Washington, D. C.
EFFECT OF HEAT TREATMENT ON THE STRUCTURE AND PROPERTIES OF VT15 WELD JOINTS
F. Ye. Tret'yakov, G. N. Kiryukhina, and A. I. Gorshkov *In its* Titanium and its alloys 15 Jul. 1965 p 31–36 refs (See N65-29356 18-17) CFSTI: $2.00

This article describes an investigation of weld joints made of VT15 alloy welded by two of the best perfected methods: argon-arc and electron-beam welding. The effect of hardening temperatures ranging from 750 to 800° C, and aging temperatures from 450 to 500° C for six to 30 hours, on the structure and properties of weld joints are investigated. The investigation established the following regime for hardening the weld joints of VT15 alloy by heat treatment: heating to 800° C and holding for 15 minutes, quenching in water, aging for 10 hours at 500° C, reheating to 560° C for 10 minutes. Hardening and aging after welding increases the ultimate strength but reduces sharply the plasticity. An increase in the duration of aging to 10 hours at 500° C helps to harden the weld and the metal to a larger degree than the weld-affected zone. Longer aging increases the hardness of the weld-affected zone, without hardening the weld and the base metal. N.E.A.

N65-29414*# Columbia Univ., New York. Henry Krumb School of Mines.

A SURVEY OF THE BEHAVIOR OF CARBON IN TUNGSTEN AS REVEALED BY FIELD-ION MICROSCOPY Technical Report No. 1

I. Gupta, E. S. Machlin, and J. Galligan [1963] 40 p refs (Grant NsG-294-63)

(NASA-CR-58977) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Field ion micrographs have been obtained from tungsten and tungsten carbon alloys which have been subjected to a variety of heat treatments. It has been found that carbon in tungsten stabilizes the formation of stacking faults. An estimate has been obtained for the binding energy of carbon to stacking faults in tungsten which is 1 ±0.25 e.v., based on the minimum temperature for annealing out the stacking faults (3000° C). Surfaces in tungsten have a much higher binding energy for carbon based on the observation that stacking faults in tips of about 10^{-6} cm diameter can be annealed out at much lower temperature. The true lattice solid solubility of carbon in tungsten is probably much smaller than previously reported. The field evaporation potential for carbon exceeds that for tungsten. It is orientation sensitive and greatest in the vicinity of the (100) poles at the surface. Author

N65-29422*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY RESULTS OF A STUDY OF 12 OXIDATION-RESISTANT COATINGS FOR Cb-10Ti-5Zr COLUMBIUM-ALLOY SHEET

Bland A. Stein and W. Barry Lisagor [1964] 21 p refs Presented at the 9th Meeting of the Refractory Composites Working Group, Worcester, Mass. 17–19 Aug. 1964

(NASA-TM-X-51973) CFSTI: HC $1.00/MF $0.50 CSCL 11C

Data is presented from preliminary results of an investigation of 12 oxidation resistant coatings on Cb-10Ti-5Zr columbium-alloy sheet. This study consists of screening tests which include continuous and cyclic oxidation tests at atmospheric pressure in slowly flowing air at 2000° F, 2400° F, and 2700° F and tensile stress–strain tests at room temperature, 2000° F and 2400° F. In addition to the results of the preliminary screening tests, this report indicates some diffusion effects for several of the coatings. More complete tensile data from room temperature to 3000° F are presented for a sheet coated with one of the coatings. N.E.A.

N65-29425*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECTS OF GRAIN SIZE ON THE TENSILE AND CREEP PROPERTIES OF ARC-MELTED AND ELECTRON-BEAM-MELTED TUNGSTEN AT 2250° TO 4140°F

William D. Klopp, Walter R. Witzke, and Peter L. Raffo 21 Jul. 1964 29 p refs Submitted for Publication

(NASA-TM-X-54756) CFSTI: HC $2.00/MF $0.50 CSCL 11F

A study was conducted of the tensile and creep properties of arc-melted and electron-beam-melted tungsten over the temperature range 2250° to 4140° F. The tensile and creep strengths vary with grain size, the finer grained materials being stronger. The temperature dependencies for transient creep, and for steady creep, correspond to activation energies of 95,000 and 141,000 cal/(g)(mole), respectively. The magnitudes of these activation energies suggest that cross-slip is rate-controlling during transient creep, while dislocation climb is rate controlling during steady creep. Author

N65-29434*# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.

[DISPERSION STRENGTHENING OF METALS] Summary Report, Jul. 1963–Jul. 1964

Nicholas J. Grant, John Benjamin, Gary Ewell, Diane Margel, Richard J. Murphey et al [1964] 41 p (Grant NsG-117-61)

(NASA-CR-59384) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The structure, stability, and properties of dispersion strengthened and internally oxidized alloys are evaluated. Submicron oxides were used to determine if oxide dispersion strengthened structures could be produced with good room temperature properties, and with high creep-rupture properties at 1800° F. Diffusion, strain field, and bulk preparation and testing of the nickel–titanium carbon system of dispersion strengthened alloys were studied. Properties of high strength and temperature oxide dispersion strenghtened alloys, produced by internal oxidation of copper–nickel–aluminum alloys, are described. Nickel–thorium dioxide and nickel–molybdenum–thorium dioxide alloys produced by selective reduction of mixed oxides were also tested. Production procedures for thorium dioxide dispersion strengthened niobium, and intermetallic compound-ductile binder composite materials are given, and their properties are discussed. C.T.C.

N65-29446*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CORROSION IN LIQUID METAL SYSTEMS

D. H. Gurinsky, J. R. Weeks, C. J. Klamut (Brookhaven Natl. Lab.), L. Rosenblum, and J. H. De Van (Oak Ridge Natl. Lab.) [1964] 15 p refs

(NASA-TM-X-54722) CFSTI: HC $1.00/MF $0.50 CSCL 11F

Current theories of liquid metal corrosion, methods employed in liquid metal testing and analysis, and the state of the art of each of the alkali metals, Hg, and liquid alloys containing Pu are reviewed. Liquid metal materials were developed and tested for higher temperature applications. Engineering tests to determine the long term behavior of containment alloys for sodium components show that the 650° C temperature range is feasible. In nuclear auxiliary power systems, refractory alloys show promise for the containment of liquid Li and are also suitable for power conversion systems using boiling K, Na, Rb, Cs, and Hg. Confirmation of the importance of impurities in the liquid metals and the containment alloys on the corrosion process resulted in advances in testing and analytical techniques. Although the precision of impurity analyses and the monitoring techniques of the liquid metals have been improved, accuracy remains uncertain because of the lack of calibration standards. The use of X-ray fluorescence and microprobe techniques has delineated the subtle surface effects due to corrosion. R.N.A.

N65-29579# Lockheed Missiles and Space Co., Sunnyvale, Calif.

FRACTURE TOUGHNESS OF X7006-T6351 ALUMINUM ALLOY PLATE WELDMENTS FOR THE LARGE (ADVANCED) STRUCTURES INDEPENDENT DEVELOPMENT PROJECT (TASK B) MATERIALS AND MANUFACTURING DEVELOPMENT

F. T. D'Annessa Jul. 1964 30 p refs

(Rept.-6-62-64-10; AD-615781)

This report is concerned with the "precracked-Charpy" fracture toughness evaluation of 3/4" X7006-T6351 plate and its weldments. Fracture toughness, $(W/A)_c$, data at room temperature and LN_2 temperature are presented for (1) four principal notch orientations in the base-metal and (2) two weld fusion zone directions to assess resistance to longitudinal and transverse weld cracking. The variation of fracture toughness of sub-thicknesses of the basic plate thickness in both the base metal and weld fusion zone is determined by using

varying width "through-thickness" notched specimens. "Through-thickness" notch data are used to calculate critical-crack size for two base-metal and two weld-fusion zone orientations. Critical-flaw sizes are calculated for both room-temperature and LN_2 temperature. The fracture toughness of the X7006 alloy is compared with that of the X7039 alloy reported in an earlier report. Author

N65-29581# Stanford Univ., Calif. Dept. of Materials Science.
INFLUENCE OF DIFFUSIVITY, ELASTIC MODULUS AND STACKING FAULT ENERGY ON THE HIGH TEMPERATURE CREEP BEHAVIOR OF ALPHA BRASSES Eighth Technical Report
R. M. Bonesteel and O. D. Sherby 1 May 1965 21 p refs
(SU-DMS-65-23; AD-615927)

The steady state creep behavior of three compositions of alpha-brass (90, 80, and 70 A/O copper) was investigated in the temperature range 550 to 700°C. Compressional creep testing was performed in dry, deoxidized hydrogen at stresses of 2800, 3400 and 4000 psi. Activation energies for creep were observed to be 38,600, 38,000 and 31,000 cal/mole for alloys containing 90, 80 and 70 A/O copper, respectively. As these values closely approximate chemical diffusion activation energies, it is thought that the rate controlling mechanism in creep of alpha-brass in the stress and temperature range studied is diffusion dependent. The steady state creep rates $\dot{\epsilon}_s$ satisfied the relationship, $\dot{\epsilon}_s = B\gamma^{3.5}(\frac{\sigma}{E})^5 D$, where B is a constant about equal to 4.4×10^{17} cm^6 $ergs^{-3.5}$, γ is the stacking fault energy, σ is the applied creep stress, E is the isotropic, polycrystalline, unrelaxed elastic modulus, and D is the chemical diffusion coefficient. Author

N65-29587# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
CRACK INITIATION IN METALLIC MATERIALS Final Report
V. Weiss, G. Nash, and K. Schroder Mar. 1963 58 p refs
(Contract NOw-64-0275-d)
(SURI-MET-E-1160-0365F; AD-615786)

Crack initiation and propagation under alternating loading has been investigated for a number of technical alloys (AISI 301, PH-15-7Mo, D6-AC, HP9-4-25, Ti-6Al-4V). The parameters n^+ and N_o relating to the crack propagation and initiation respectively have been introduced through the use of a crack propagation law suggested by Weiss and have been correlated with the specimen geometries and material properties. The parameter n^+ is thought to depend in some way on the strain hardening coefficient of the material and is found to provide an indication of the material's resistance to fatigue crack propagation. The parameter N_o is related to the crack initiation times and a relation between N_o, the geometry of the specimen, and the parameter n^+ has been proposed. Author

N65-29590# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
PLATING BERYLLIUM-COPPER ALLOY WITH A COPPER-SILVER-GOLD LAMINATE
W. H. Roberts Oak Ridge, Tenn., AEC, 11 Jan. 1964 7 p refs
(Contract AT(29-1)-1106)
(RFP-366)

A procedure was developed for plating a beryllium-copper alloy with a flash of copper, then a flash of silver, and finally a bright gold electrodeposit. Eight basic steps are listed: (1) degrease, (2) clean ultrasonically, (3) alkaline or detergent clean, (4) pickle, (5) neutralize, (6) copper strike, (7) silver strike, and (8) gold electroplate. After a thorough water rinsing, a Cu-Ag-Au laminate was developed which is both sound and attractive. Precleaning is considered the most important phase, particularly acid pickling which deoxidizes, brightens, and thereby activates the alloy for subsequent electrodeposition. W.M.R.

N65-29646# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ELECTROLESS NICKEL PLATING ON ALUMINUM
W. H. Roberts Oak Ridge, Tenn., AEC, 10 Jan. 1964 7 p refs
(Contract AT(29-1)-1106)
(RFP-367)

A procedure was developed for deposition of a coherent coating of electroless nickel on an aluminum surface. Three closely controlled steps ensure a successful product: (1) chemical deposition of an intermediate zinc film, which is very thin and continuous, from a dilute zincate solution; (2) autocatalytic nickel deposition to the desired thickness from a slow-bright-alkaline electroless nickel solution; and (3) short term heat treatment, preferably in vacuo unless coated finally with an electrodeposit of gold. The nickel serves to protect the substrate of 6061 aluminum without impeding electrical conduction. J.M.D.

N65-29661# California Univ., Berkeley. Lawrence Radiation Lab.
SELECTED VALUES OF THERMODYNAMIC PROPERTIES OF METALS AND ALLOYS Supplement
Ralph Hultgren, Raymond L. Orr, and Kenneth K. Kelley 1963 76 p refs

Presented are supplementary selected values on the thermodynamic properties of carbon (graphite and diamond), molybdenum, plutonium, and tungsten. Included are revised tables containing data on phases and structures, gas properties, low- and high-temperature measurements, and vapor pressures. Also included are extensive lists of references. S.C.W.

N65-29694# Battersea Coll. of Technology, London (England).
USE OF REACTIVE ATMOSPHERES FOR THE TREATMENT OF B.C.C. METALS Quarterly Engineering Progress Report, 1 Jan.–31 Mar. 1965
[1965] 5 p
(Contract N62558-3591)
(QPR-10; AD-616273)

The sintering of tungsten compacts impregnated with solutions of palladium chloride or nickel chloride were investigated in a study on the theoretical aspects of activation sintering mechanisms. Further testing confirmed the effectiveness of post-sintering treatments for improving the ductility of palladium and nickel activation sintered specimens. The sintering kinetics of tungsten activated by nickel and palladium are being studied. The optimum concentration of the activator was found to be 0.130 wt% of nickel and 0.317 wt% of palladium. Additions of thoria to stabilize and tungsten grain have no effect on this. Rate exponents and activation energies for the sintering process were determined and a theoretical model was devised. Test pieces were prepared under standardized conditions for studies of the de-embrittling treatments. R.N.A.

N65-29696# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INVESTIGATION OF BONDING IN OXIDE-FIBER (WHISKER) REINFORCED METALS Second Quarterly Report, 1 Oct.–31 Dec. 1964
Willard H. Sutton and Earl Feingold [1964] 35 p refs
(Contract DA-19-066-AMC-184(X))
(AMRA-63-01/2; AD-615817)

The character of wetting and bonding between single crystal sapphire (α-Al_2O_3) and sessile drops of nickel doped with 1 atomic percent of chromium, titanium or zirconium was

studied. Bonding in these systems was found to proceed in the following manner: (1) segregation of the active metal, (2) concentration of the active metal at the interface, (3) reaction of active metal with the sapphire substrate, (4) formation of new crystalline phases at the interface, with (5) diffusion of the active metal into the sapphire. Detailed investigations of metal/sapphire interfaces were conducted using the methods of X-ray diffraction optical and electron microscopy and microhardness. An hypothesis for the mode of bond failure relating to the nature of the underlying sapphire surface is presented. Differences between true interfacial bonding and 'engineering bonding' were noted and are described. Author

N65-29738*# National Aeronautics and Space Administration, Washington, D. C.

SPONTANEOUS TRANSITION OF SLIDING FRICTION TO ROLLING FRICTION IN THE HIGH-TEMPERATURE TESTING OF REFRACTORY CARBIDES [SPONTANNYY PEREKHOD TRENIYA SKOL'ZHENIYA V TRENIYE KACHENIYA PRI VYSOKOTEMPERATURNYKH ISPYTANIYAKH TUGOPLAVIKH KARBIDOV]

A. P. Semenov and V. V. Pozdnyakov Jul. 1965 9 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 160, no. 5, 1965 p 1057–1060
(NASA-TT-F-9499) CFSTI: HC $1.00/MF $0.50 CSCL 11F.

Two specimens, both of vanadium or molybdenum carbide, were friction tested by being made to rub together in vacuum with simultaneous heating and subsequent cooling. When heated, the specimens manifested a decrease in mean friction coefficient, in one case from 0.6 to 0.3, then the onset of oscillations in the friction coefficient with a sharp rise in friction coefficient (to 0.85), and, finally, the spontaneous transition from sliding to rolling friction with a concomitant drop in the mean friction coefficient to 0.05. The effect is explained by a surface-geometric mechanism, whereby the surfaces in contact crumble at high temperature, ejecting balls of the tested material, which fit into pits or grooves and act as roller bearings. Author

N65-29788# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics.

PHASE TRANSFORMATIONS IN THE ALLOY–Ti:8%Al:1%Mo:1%V

Martin J. Blackburn Jan. 1965 83 p refs
(DI-82-0402)

The micro-structures of the alloy Ti:8%Al:1%Mo:1%V after various heat treatments have been studied by transmission electron microscopy. An ordering reaction occurs in the α phase, the critical temperature for the reaction being ~525° C, electron diffraction results are consistent with the formation of a DO_{19} type superlattice. The β-phase transforms martensitically when quenched from temperatures above ~875° C. Two forms of martensite have been found, a heavily faulted hexagonal or face centered cubic structure α' formed at low temperatures and a hexagonal structure α'' formed at higher temperatures. Ageing of a supersaturated β-phase or the martensitic structures α' or α'' result in the formation of mixtures of the α and β-phases, however, the reaction mechanisms are shown to be dependent on the initial structures. The results are related to some of the mechanical properties of the alloy and an attempt is made to account for the differences in properties of Duplex and Mill Annealed material. Author

N65-29815*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FE-NI PHASE DIAGRAM

J. I. Goldstein and R. E. Ogilvie (MIT) Mar. 1965 20 p
(NASA-TM-X-55248; X-640-65-117) CFSTI: HC $1.00/MF $0.50 CSCL 11F

The α and γ solubility limits in the Fe–Ni phase diagram have been redetermined at temperatures above 500° C. Both a diffusion couple and a quench-and-anneal technique were used. The solubility limits were measured with an electron probe microanalyzer. The Ni concentration at the $\gamma/\alpha+\gamma$ phase boundary is increased below 700° C and the α solid solubility range is much larger than had been previously measured. The solubility limits were also extrapolated to 300° C. It is suggested that the $\alpha/\alpha+\gamma$ boundary bends back to lower Ni contents above 400° C. Author

N65-29821*# Michigan Univ., Ann Arbor.

THE MECHANICAL PROPERTIES OF INCONEL 718 SHEET ALLOY AT 800°, 1000°, AND 1200°F

T. M. Cullen and J. W. Freeman Washington, NASA, Jul. 1965 56 p refs
(Grant NsG-124-61)
(NASA-CR-268) CFSTI: HC $3.00/MF $0.50 CSCL 11F

An investigation has been conducted to evaluate the potential usefulness of Inconel 718 sheet material in the supersonic transport. Because of the likelihood that this superalloy would only see service in the hottest portions of the aircraft skin, the evaluation of its potential usefulness has been based on creep and rupture properties in the temperature range from 800° to 1200° F. The results showed that the creep and rupture properties of the alloy were sensitive to the prior thermal history the alloy had received. Evaluation of the results from the viewpoint of the expected design criteria showed that the alloy annealed at 1750° F and aged offered the most potential for application in the supersonic transport. In this condition the alloy should be serviceable up to approximately 1150° F. Author

N65-29831# Joint Publications Research Service, Washington, D. C.

ELECTROSLAG REMELTING AND METAL QUALITY

S. A. Leybenzon 2 Aug. 1965 49 p refs Transl. into ENGLISH from the book "Elektroshlakovyy Pereplav i Kachestvo Metalla," Moscow, Metallurgia Publishing House, 1965 p 19–63
(JPRS-31348; TT-65-31845) CFSTI: $2.00

Electroslag remelting is discussed in terms of technology, materials, and industrial uses under various subject matter headings. A new method for obtaining steel by the electroslag remelting method is included, and the effect of electrical melt conditions on electroslag remelted steel is considered. Effect of slag composition and its electroconductivity on technical and economic indices of the remelting process is discussed, as are the advantages of ingot crystallization. A comparison is presented for the quality of several grades of steels before and after electroslag remelting. Production of chrome nickel steel, and the remelting of stainless steel are also considered. M.W.R.

N65-29842# Stanford Univ., Calif. Dept. of Materials Science.

EFFECT OF GRAIN SIZE AND ANNEALING TREATMENT ON STEADY STATE CREEP OF COPPER Seventh Technical Report

C. R. Barrett, J. L. Lytton (Lockheed Res. Lab.), and O. D. Sherby 1 May 1965 35 p refs Presented at the Meeting of the Met. Soc. of the Met. Soc. of the AIME, Philadelphia, Oct. 1964
(Contract Nonr-225(60))
(DMS-65-22; AD-615926)

Randomly oriented polycrystalline copper of 99.995% purity was tested in tension at temperatures of 626, 498 and 406° C. The grain size range investigated was from 0.03 mm to

0.7 mm. Grain sizes were produced by two techniques: (1) varying the amount of prior cold work and the annealing time at constant annealing temperature so as to obtain various recrystallized grain sizes with minimum grain growth and (2) holding the prior cold work constant while varying the annealing time or temperature so as to obtain varying grain sizes by grain growth. Polycrystalline samples (grain size of 0.03 mm) with a strong [001] (100) texture were also studied. Author

N65-29870# IIT Research Inst., Chicago, Ill. Technology Center.
EMBRITTLEMENT OF METALS BY ORGANIC LIQUIDS Summary Report, 1 Mar. 1964–31 Mar. 1965
W. Rostoker 24 May 1965 35 p refs
(Contract DA-11-ORD-022-3108)
(IITRI-B18382-8; AD-616302)

The published literature on this subject is reviewed. The essential details of reduced fatigue life of steel in the presence of certain polar liquids discovered by Karpenko are confirmed. Studies on polar liquids and solutions have been expanded to include a wider variety of longchain organic species and a number of metallo-organic liquids. It is shown that fatigue life increases with increasing carbon chain length. In all cases the plot of fatigue life against carbon chain length extrapolates to the value for water. Further study has shown that in the presence of a strong dehydration agent, the embrittlement effect disappears. It is concluded that water content in solution is the fundamental factor governing the incidence of reduced fatigue life. However, the mechanism of failure in the presence of water is not clear. A number of experiments are described which suggest that current convictions are not tenable. Author

N65-29891# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRIC RESISTANCE OF ORDERED ALLOYS WITH A HEXAGONAL CLOSE-PACKED CRYSTALLINE LATTICE
Z. A. Matysina, A. I. Nosar', and A. A. Smirnov 19 May 1965 10 p refs Transl. into ENGLISH from Sb. Nauch. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR (Kiev), no. 14, 1962 p 121–125
(FTD-TT-65-84/1+2; AD-617156)

The residual electric resistance of binary ordered alloys with hexagonal close-packed crystalline lattice of the type AB and AB is considered and comparisons are made of the results with experimental data from the alloys $MgCd_3$ and Mg_3Cd. The crystalline lattice is considered as geometrically ideal, that is, not having any geometrical distortions in the whole interval of the concentration of the alloys. The difference $/v_A - v_B/$ of the energies of the interaction of the conductance electron with ions of A and B kinds are considered to be small values and in the results the terms of the second order of smallness are preserved. N.E.A.

N65-29892# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF PLASTIC DEFORMATION OF THE GAMMA PHASE ON THE STRENGTHENING OF IRON–NICKEL ALLOY DURING SUBSEQUENT MARTENSITIC TRANSFORMATION
Yu. N. Koval' and L. G. Khandros 24 May 1965 10 p refs Transl. into ENGLISH from Sb. Nauchn. Rabot Inst. Metallofiz., Akad. Nauk Ukr. SSR (Kiev), no. 18, 1964 p 69–73
(FTD-TT-65-85/1+2; AD-617157)

Hardness in iron–nickel alloy was studied by X-ray determinations of the phase state of thermally treated specimens that are subsequently cooled and supercooled. The effects on hardness connected with the plastic deformation of the supercooled austenite, and the martensitic conversion are considered. A table showing the results of hardness measurements together with the approximate makeup of the processed specimens is given. As the degree of deformation increases, the intensification of hardness brought about by the deformation increases, and the hardening connected with the martensitic conversion decreases. No essential difference between the sizes of the mosaic blocks of the α-phase in specimens subjected to different degrees of reduction (compression) in the austenite state, and in the undeformed specimens after intense cooling was revealed. L.S.

N65-29952*# Battelle Memorial Inst., Columbus, Ohio.
TECHNICAL AND ECONOMIC STATUS OF MAGNESIUM-LITHIUM ALLOYS
Paul D. Frost Washington, NASA, Aug. 1965 51 p refs Sponsored by NASA
(NASA-SP-5028) GPO: HC$0.25; CFSTI: MF$0.50 CSCL 13H

The present space usage and the future commercial usefulness of magnesium-lithium alloys are considered. The characteristics of these alloys are reviewed, and the manufacture and hardware development are discussed. Further, the economics and concepts for increased use of these alloys are included. It is observed that, even without reductions in current prices, the magnesium-lithium alloy applications in space components will increase gradually if the present rate of effort in space exploration is maintained. The requirements to reduce weight as space-flight vehicles increase in size is a strong incentive to make use of these alloys. Although there are few facts available on which to base a prediction, an annual consumption of one to two million pounds of mill products for space application would not be surprising 5 to 10 years from now. This usage will probably not become a reality until the Apollo program is successful and lunar exploration actually begins. At that time it will be necessary to construct large quantities of space equipment from the lightest metals available and the magnesium-lithium alloys should be very much in demand. E.E.B.

N65-30014# Rock Island Arsenal Lab., Ill.
CORROSION RESISTANCE OF BLACK OXIDE COATINGS ON MILD AND CORROSION RESISTANT STEELS
Linden H. Wagner 21 Dec. 1964 23 p refs
(RIA-64-3580; AD-615941)

In the revision of Military Specification MIL-C-13924A, dated 29 December 1956, the various processes were reviewed and evaluated for their effectiveness in blackening mild steel, 300 and 400 corrosion resistant steels. The corrosion resistance of these coatings were also investigated. A low temperature Class 4 proprietary alkaline-oxidizing process was proposed for blackening only the 300 series stainless steels in lieu of the fuzed salt oxidizing process which operates at 760° F. Author

N65-30023# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
A SUMMARY OF ORNL WORK ON DIFFUSION IN β-Zr, V, Nb, AND Ta
T. S. Lundy, J. I. Federer, R. E. Pawel, and F. R. Winslow [1964] 15 p refs Presented at the Symp. on Body-Centered Cubic Mater., Gatlinburg, Tenn., 16–18 Sep. 1964
(Contract W-7405-ENG-26)
(ORNL-P-425; CONF-691-10)

Diffusion coefficients were measured over wide ranges of temperature in beta-zirconium, vanadium, niobium, and tantalum. Radioactive tracer methods were combined with mechanical sectioning techniques to determine activity profiles after specimens were subjected to isothermal diffusion annealing treatments. Deviations from Arrhenius behavior were found in

all cases. For niobium and tantalum these deviations can be explained in terms of short circuiting. Similar explanations probably do not hold for diffusion in beta-zirconium. R.N.A.

N65-30041# Franklin Inst., Philadelphia, Pa. Labs. for Research and Development.
DIRECT STUDY OF DISLOCATIONS IN METALS BY TRANSMISSION ELECTRON MICROSCOPY–FATIGUE DEFORMATION
A. Lawley, J. D. Meakin, and K. U. Snowden Wright-Patterson AFB, Ohio, ARL, Jan. 1965 57 p refs
(Contract AF 33(657)-10360)
(ARL-65-11; AD-616352)

High-purity single crystals of molybdenum have been subjected to cyclic loading in various modes: (1) bend fatigue at 1800 cpm (2) axial tensile fatigue at 1724 cpm (3) compression fatigue at 5 cpm. The resultant dislocation substructure has been examined by transmission electron microscopy, and in the case of the bend fatigue crystals, the surface slip structure studied by light microscopy, and electron microscopy of surface replicas. Author

N65-30054# Oak Ridge National Lab., Tenn.
SHORT-RANGE ORDER AND K-STATE
Hans Günter Baer [1965] 11 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), no. 2, (1965) p 79–84
(ORNL-TR-632)

A short-range order was found roentgenographically in nickel-rich alloys of the nickel–tungsten and nickel–molybdenum system. The phenomena of the K-state are attributed to it. The relationship between the short-range order and the long-range order occurring also in each of the two systems is discussed and it was concluded from X-ray results as well as from the fact that the formation of the long-range order proceeds via nucleation, that the short-range order is not directly transformed into the long-range order in the case of these K-state alloys. Short-range and long-range orders can exist side-by-side. A parallelism to the nickel–chromium system is shown. The cold-worked state approaches most closely that of the statistical solid solution. Author

N65-30056# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
DIFFUSION OF TITANIUM-44 AND VANADIUM-48 IN TITANIUM
J. F. Murdock [1964] 11 p refs Presented at Symp. on Body-Centered Cubic Mater., Gatlinburg, Tenn., 16–18 Sep. 1964 Sponsored by AEC
(ORNL-P-351; CONF-711-2)

The diffusion of titanium-44 and vanadium-43 in the body-centered cubic phase of iodide titanium has been studied over the temperature range 900 to 1550° C. The resulting Arrhenius-type plots show curvature with the apparent activation energies and frequency factors increasing with temperature. The various possible interpretations of this behavior are considered. Author

N65-30080# National Gas Turbine Establishment, Pyestock (England).
LOW FREQUENCY FATIGUE OF NIMONIC 90
C. S. Landau Sep. 1960 31 p refs
(NGTE-R-243)

An alloy of Nimonic 90 type has been tested under cyclic loads at temperatures of 800, 850 and 900° C. Graham's descriptive theory of deformation has been applied to these test conditions and shown to provide a satisfactory description of the experimental results. The variation of cumulative strain with number of cycles is described by an equation exactly similar to the already established creep equation, i.e. by the sum of powers of cycle number $n^{1/3}$, n, n^3, and n^9. The effect of variation of maximum stress/cycle can be described by the sum of power terms whose exponents are taken from the Graham-Walles standard series. Within the scatter of observation, the variation of cumulative deformation with time and the total time to fracture are independent of the frequency. There is qualitative agreement between the observed and the predicted stress/strain loops. Author

N65-30081# National Gas Turbine Establishment, Pyestock (England).
THE EFFECT OF ALTERNATING STRESSES AT ELEVATED TEMPERATURES ON STRUCTURAL CHANGES IN NIMONIC 90
J. E. Northwood, R. S. Smith, and N. Stephenson London, Min. of Aviation, Jul. 1959 48 p refs
(NGTE-M-325)

Fatigue properties were determined in the range 20 to 1,000° C at frequencies of 4,400 and 8,700 c/min, with additional tests at 15,000 c/min at 20° C. At 700° C time and cycles to failure were increased at the higher frequency, but no frequency effect was observed at higher temperatures. At temperatures above about 700° C fatigue strength was reduced in an approximately linear relationship with temperature. With increase in temperature or time the ratio dynamic/static stress to rupture for the same lives increased until the material became stronger in fatigue than in creep. Metallographic examination revealed transgranular fracture with isolated intergranular cracks for a test temperature of 700° C at long durations, but the transition from completely transgranular to completely intergranular fracture was more gradual than that suggested by visual examination (975 to 987° C). At elevated temperatures, cyclic stressing accelerated diffusion dependent structural changes. Author

N65-30115# Martin Co., Denver, Colo.
CRYOGENIC MATERIALS DATA HANDBOOK, SUPPLEMENT TO ML-TDR-64-280 Progress Report No. 2
F. R. Schwartzberg, S. H. Osgood, R. D. Keys, and T. F. Kiefer Jul. 1965 267 p refs
(Contract AF 33(657)-9161)
(PB-171809 (Rev.); AD-618065)

N65-30141# Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.
DEFORMATION PROCESSING OF ANISOTROPIC METALS Final Report, 1 Jul. 1963–30 Jun. 1964
Jan. 1965 29 p refs
(Contract NOw-63-0564-d)
(AD-617108)

Various textured sheet materials show strong degrees of plastic anisotropy resulting in large deviations in the yield locus from the isotropic von Mises ellipse. In the case of α Titanium with an (0002) texture normal to the plane of the sheet this results in large increases in yield strength under conditions of combined stress relative to the uniaxial strength. Since deformation in sheet rolling occurs in plane strain these increases would be reflected in higher roll gap pressures and mill strength requirements. A procedure for the experimental determination of the yield locus which uses only uniaxial tension and compression and plane strain compression is described. The yield locus for plastically-anisotropic material can also be predicted from the Hill theory using only the uniaxial yield strength and a parameter, R, which is the ratio of width to thickness strains in a uniaxial test provided that the deformation mode and yield strength are independent of the sign of the stress. Agreement of the predicted and experimental loci was very good in the tension-tension quadrant in α titanium

textured with (0002) normal to the sheet. Discrepancies in the compression-compression quadrant are a result of $10\bar{1}2$ mechanical twinning with compression normal to the c axis. Some additional experiments on the temperature dependence of plastic anisotropy in titanium, and plastic anisotropy in f.c.c. solidification textures are also discussed. Finally some observations of superplasticity in Ti–5Al–2.5Sn are described. Author

N65-30166*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DEVELOPMENT OF DISPERSION STRENGTHENED TANTALUM BASE ALLOY Fifth Quarterly Report, Nov. 20, 1964–Feb. 19, 1965
R. W. Buckman, Jr. [1965] 35 p refs
(Contract NAS3-2542)
(NASA-CR-54462; WANL-PR(Q)-006) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Development of dispersion strengthened tantalum base alloys for use in advanced space power systems continued with selection of the sheet and tubing alloy composition Ta-8W-1Re -0.7 Hf-0.025C for detailed evaluation. Scale-up of this composition to a four-inch diameter ingot was initiated. Selection of seven additional compositions in the Ta-Mo-Re-W-Hf-Zr-C-N system were made to further optimize the Ta-5.7 W-1.56 Re-0.7 Mo-0.25 Hf-0.13 Zr-0.015C-0.015N alloy. Response to heat treatment investigation continued and carbides and nitrides were shown to be stable in the tantalum alloy matrix at temperatures up to 1250° C and at pressures of 10^{-10} torr for 500 hours. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-29154# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
RESISTANCE OF PLASTICS TO OUTDOOR EXPOSURE
Frederick J. H. Blinne and Lester E. Day Apr. 1964 45 p refs
(PA-TR-2102, Addend. 5; AD-609405)

This report presents stress-strain diagrams showing the tensile properties of 32 sets of samples of plastics before exposure, after being stored for three years in the dark under standard laboratory conditions, and after outdoor exposure for periods up to three years in three climates, temperate, arctic and tropical. Author

N65-29265# Radiation Applications, Inc., Long Island City, N. Y.
UPGRADING OF POLYMERIC MATERIALS FOR ELECTRICAL APPLICATIONS Final Report, 2 Jul. 1962–15 Oct. 1964
Bruce S. Bernstein, Sebastian Tirelli, George Odian, and Sidney Binder 15 Oct. 1964 83 p refs
(Contract DA-49-186-502-ORD-1095)
(RAI-339; AD-463790)

Radiation crosslinking of polyethylene, polypropylene, and an ethylene–propylene copolymer were studied with emphasis on thermal upgrading while simultaneously considering dielectric properties. Both machine and gamma radiation crosslink polyethylene, but gamma radiation is more effective at lower doses in the presence of multifunctional monomers. Polypropylenes require small quantities of polyfunctional monomers. Polypropylenes require small quantities of polyfunctional monomers for efficient crosslinking. Allyl methacrylate, divinyl benzene, and diallyl maleate are effective with polyethylene; the former is effective with polypropylenes. Monomers have a negligible effect on dielectric constant or dissipation factor after gamma radiation up to 8 Mrads in nitrogen. Crosslinked polyethylene exhibits improved tensile strength in the absence of polymer crystallinity. Crosslinked polypropylene shows improved creep behavior under elevated temperatures. The properties of both polymers improve with increasing degrees of crosslinking. Tensile strength at ambient increases with dose for the polymer multifunctional monomer combinations. R.N.A.

N65-29459*# Stanford Research Inst., Menlo Park, Calif.
MECHANICAL PROPERTIES OF CROSSLINKED POLY(METHYL METHACRYLATE) POLYMERS UNDER SPACE ENVIRONMENTAL CONDITIONS Quarterly Technical Summary Report No. 3, Dec. 1, 1963–May 31, 1964
N. W. Tschoegl and T. L. Smith Jun. 1964 24 p refs
(Contract NASr-49(13); SRI Proj. PRU-4520)
(NASA-CR-58095) CFSTI: HC $1.00/MF $0.50 CSCL 07C

Tensile stress-strain data were obtained on two samples of poly(methylmethacrylate) (PMMA) crosslinked to differing degrees with glycol dimethacrylate, and on one sample of uncrosslinked PMMA. Plots are shown of the reduced stress vs. time for the uncrosslinked PMMA at different strain values; a failure envelope was obtained from break data on the same material. The concept of the failure envelope, hitherto applied only to crosslinked elastomers, is applicable also to uncrosslinked materials; however, the accessible portion of the future envelope is reduced because data obtained in stress-strain regions where either yield or flow occurs do not lie on the failure envelope. The stress relaxometer for continuous and intermittent stress relaxation measurements is described in detail; results in a trial experiment on uncrosslinked PMMA *in vacuo* are presented. Author

N65-29570# Mellon Inst., Pittsburgh, Pa.
[THE DEPENDENCE OF THE VISCOELASTIC MECHANICAL PROPERTIES OF POLYMERIC MATERIALS ON MOLECULAR AND MORPHOLOGICAL STRUCTURE] Technical Report, Sep. 1, 1964–Feb. 28, 1965
[1965] 145 p refs
(Contract Nonr-2693(00))
(TR-13; AD-615595)

CONTENTS:

1. AN INFRARED STUDY OF THE INTERACTION OF POLYAMIDES WITH IODINE IN IODINE–POTASSIUM IODIDE SOLUTION I. Matsubara and J. H. Magill 44 p refs (See N65-29571 18-06)

2. TEMPERATURE DEPENDENCE OF THE VISCOELASTIC BEHAVIOR OF POLYSTYRENE D. J. Plazek 23 p refs (See N65-29572 18-18)

3. POLYETHYLENE—MECHANICAL PROPERTIES VS. MORPHOLOGY D. J. Plazek 31 p refs (See N65-29573 18-18)

4. THE PREPARATION AND CHARACTERIZATION OF SOME STAR- AND COMB-TYPE BRANCHED POLYSTYRENES T. Altares, Jr., D. P. Wyman, V. R. Allen, and K. Meyersen 38 p refs (See N65-29574 18-06)

N65-29572 Mellon Inst., Pittsburgh, Pa.
TEMPERATURE DEPENDENCE OF THE VISCOELASTIC BEHAVIOR OF POLYSTYRENE

Donald J. Plazek *In its* [The Dependence of the Viscoelastic Mech. Properties of Polymeric Matrs. on Mol. and Morphological Struct.] [1965] 23 p refs (See N65-29570 18-18)
(Grant NsG-147-61)

The creep and recovery behavior of a narrow molecular weight distribution polystyrene sample was measured from 97.0° to 160° C. Measurements were carried out on this 46,900 molecular weight sample in a creep apparatus that employs a magnetically levitated rotor in which constant torques are induced by means of a drag cup motor. Creep compliances measured extend from 10^{-10} to above 10^{-4} cm^2/dyne. Simple superposition of the results to obtain a reduced master curve was not possible, because the viscous flow contributing to the total measured compliance had a different temperature dependence from that of the recoverable compliance. The recoverable compliance results by themselves were reducible. The temperature dependences obtained were analyzed in terms of free volume parameters. Author

N65-29573 Mellon Inst., Pittsburgh, Pa.
POLYETHYLENE—MECHANICAL PROPERTIES VS. MORPHOLOGY
Donald J. Plazek *In its* [The Dependence of the Viscoelastic Mech. Properties of Polymeric Matrs. in Mol. and Morphological Struct.] [1965] 31 p refs (See N65-29570 18-18)

Described are several techniques and apparatus that were used to study the mechanical properties and morphology of a high density polyethylene designated Bakelite-10. Included are data on a resonance method for measuring internal friction and elastic constants of low loss materials; and a laser light scattering apparatus for describing the morphology of crystalline polymers. Also described is a stabilization technique (optical feedback) for photomultipliers. Presented are results obtained with the new self-excited resonance apparatus. S.C.W.

N65-29634# Royal Aircraft Establishment, Farnborough (England).
HIGH SPEED ABRASION OF NYLON CORDAGE ON NYLON
J. E. Swallow and M. W. Webb London, Min. of Aviation, Aug. 1964 29 p refs
(RAE-TN-CPM-83)

Abrasion measurements have been made between a braided nylon cord carrying a known load and a nylon surface mounted on the periphery of a rotating wheel. The tension produced by friction was measured by a capacitance gage and the temperature monitored by thermocouples at the center and surface of the cord. Relationships of temperature with velocity, load and work were determined. Experimental and theoretical temperatures were compared. The abrasion mechanism is largely controlled by the conversion of frictional work into heat. The heat front is steep. This suggests that a thin layer of high melting material would afford protection. Author

N65-29670# Peninsular ChemResearch, Inc., Gainesville, Fla.
SYNTHESIS AND POLYMERIZATION OF FLUORINATED SULFUR MODIFIED NITROSO RUBBER Quarterly Report, 1 Jan. 1965–31 Mar. 1965
Eugene C. Stump, Ward H. Oliver, and Calvin D. Padgett 23 Apr. 1965 33 p
(Contract DA-19-129-AMC-152(N))
(QR-7; AD-466539)

Perfluorobutadiene has been reacted with oxygen in sunlight to give a mixture of products possible containing perfluorobutadiene monoxide. Reaction of tetrafluoroethylene with nitrosyl bromide gave CF_2BrCF_2NO and a lower boiling nitroso compound, as yet unidentified. Perfluorosuccinic anhydride did not react with nitrosyl chloride at room temperature. Pyrolysis of $CH_3OOCCF_2CF_2COONO$ gave a blue product believed to be $CH_3OOCCF_2CF_2NO$. A larger reactor for the pyrolysis of CF_3COONO was constructed. About 120 g. of CF_3NO is produced in 8 hours. The addition of nitrosyl chloride to $CF_3NO/CF_2{=}CFCF{=}CF_2$ copolymer gives a blue polymer containing nitroso groups and having a Tg of −85°. CF_3OF was added to $CF_3NO/CF_2{=}CF_2/CF_2{=}CFCH{=}CH_2$ terpolymer. A gum copolymer having a Tg of −48° has been prepared from $CF_3NO/CF_3SCF{=}CF_2$. Copolymers of $CF_2{=}CFBr$ with CF_3NO and terpolymers with $CF_3NO/CF_2 = CF_2$ have been prepared. $CF_2 = CFBr$ apparently has a higher reactivity ratio than $CF_2 = CF_2$ in this polymerization. An attempt to incorporate p-trifluorovinylbenzoic acid as a termonomer was not successful. Author

N65-29724*# Goodyear Aerospace Corp., Akron, Ohio.
PROGRAM FOR THE EVALUATION OF STRUCTURAL REINFORCED PLASTIC MATERIALS AT CRYOGENIC TEMPERATURES Annual and Fourth Quarterly Report, 23 Jun. 1963–28 Jun. 1964
L. W. Toth, T. J. Boller, A. H. Kariotis, and F. D. Yoder 25 Jul. 1964 208 p *Its* Progress Rept.-12
(Contract NAS8-11070)
(NASA-CR-64005; GER-11214-S/11) CFSTI: HC $8.00/MF $1.25 CSCL 11I

This summary report documents critical assessment and evaluation of procedures, test specimens and test techniques for application to structural reinforced plastic materials at cryogenic temperatures. Basic mechanical and thermal property determinations were investigated throughout the range of 298 to 20° K. A controlling consideration in this effort has been the development of systematized procedures to yield reliable design data for the prediction of the performance of reinforced plastic materials in this temperature range. These procedures could then lead ultimately to a design handbook containing data for a variety of candidate materials useful in cryogenic applications. The mechanical properties tests at cryogenic temperatures have shown the expected significant increase in strength as the temperature decreases. The magnitude of the ultimate strengths, however, has in certain cases exceeded expectations. Of even greater importance in this program is the fact that the modes and location of the failures of the individual specimens have indicated that the ultimate strengths of the materials are being determined by the test specimens and methods employed. The testing program has shown that the properties of fiberglass laminates lend themselves to cryogenic application. Author

N65-29725*# National Aeronautics and Space Administration, Washington, D. C.
THE MECHANICAL PROPERTIES OF ANISOTROPIC LAMINATED PLASTICS IN SHORT-TIME TESTS [MEKHANICHESKIYE SVOYSTVA ANIZOTROPNYKH SLOISTYKH PLASTIKOV PRI KRATKOVREMENNYKH ISPYTANIYAKH]
N. T. Smotrin and V. M. Chebanov Jul. 1965 20 p refs Transl. into ENGLISH from Issled. po Uprugosti i Plastichnosti, Sb. 2, Izd. Leningr. Univ. (Leningrad), 1963 p 219–233
(NASA-TT-F-9437) CFSTI: HC $1.00/MF $0.50 CSCL 11I

Procedure and equipment for testing of the mechanical properties of Russian-produced glass-fiber anisotropic laminated plastics and textolite sheets, with epoxyphenolic and bakelite binders at various ratios of longitudinal to transverse fibers, are described. Tabulated data and graphs give results of tensile, compression, impact, and shear tests. An equation is derived for calculating the tensile strength σ_b in various directions of the fibers and for computing the variations in proportional limit σ_p, showing close agreement between experimental

and calculated values. Tensile and compressive strength were excellent, but shear strength was extremely low (25 to 30 kg/cm^2). Author

N65-29872# Akron Univ., Ohio. Inst. of Rubber Research.
MOLECULAR STRUCTURE AND PHYSICAL BEHAVIOR OF POLYMERS Technical Documentary Report, 1 Jan.–31 Dec. 1964
A. E. Fields, A. N. Gent, and V. V. Vickroy Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1965 42 p refs
(Contract AF 33(657)-10868)
(ML-TDR-64-19, Pt. II; AD-616097)

Crosslinked samples of high molecular weight linear polyethylene have been prepared by irradiation in the molten state. The elastic and photo-elastic properties have been examined in simple extension. The rate of solvent uptake has been studied and the equilibrium swelling determined in five solvents. These measurements have yielded values for (1) the molecular weight between entanglements, (2) the efficiency of crosslinking by irradiation, (3) the polymer-solvent interaction parameter for polyethylene with tetralin, decalin, cyclohexanone, p-xylene and chlorobenzene, (4) the optical anisotropy of the random link. The latter value is in reasonable accord with Saunders' data, but shows a marked decrease with increasing temperature. Author

N65-29888# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
LIGHT RESISTANCE OF POLYPROPYLENE AND PROPYLENE-BASE FIBER
L. G. Tokareva and N. V. Mikhaylov 12 May 1965 10 p refs Transl. into ENGLISH from Khim. Mashinostr. (Moscow), no. 3, 1962 p 23–25
(FTD-TT-65-21/1; AD-617094)

An investigation was made of the process of accelerated light aging of polypropylene and propylene base fibers and effective stabilizers were found for chemical and physico-mechanical properties of polypropylene fibers against the effect of ultraviolet radiation at higher temperature. It is shown, that the most effective stabilizers at photochemical destruction of polypropylene are: product 264-phosphite and product 26, in the presence of which at accelerated light (photo) aging there is practically total retention of the initial physico-mechanical properties of the fibers. It was established, that many stabilizers of thermooxidation destruction of polypropylene, such as for example, products 264, 264-phosphite etc. appear to be simultaneously inhibitors of photo-chemical reactions of polypropylene destruction. The phenomenon of combined effect of polypropylene stabilizers, which has been previously established on polyamides, allows an assumption about the possibility of creating polypropylene stabilizers with complex properties. An assumption was made, explaining the mechanism of simultaneous appearance in stabilizers of propylene fibers of inhibiting properties against thermooxidizing and light destruction of the polymer. Author

N65-29917# Atlantic Research Corp., Alexandria, Va.
BEHAVIOR OF NOZZLE MATERIALS UNDER EXTREME ROCKET MOTOR ENVIRONMENTS Final Technical Report, 1 May 1964–31 May 1965
J. D. Batchelor and E. L. Olcott Jun. 1965 95 p refs
(Contract NOw-64-0393-c)
(AD-467039)

The objective of this program was to study in the laboratory the behavior of graphites and refractory carbides under conditions similar to propellant exhaust exposure. A laboratory test, in which a nitrogen plasma with added reactive gases was passed through the bore of a tubular specimen, was developed to correspond to the flow geometry in a nozzle. Surface temperatures of 3000° to 5500° F were measured. Many of the results with the graphite-CO_2 reaction system indicated the limitation of mass transport control, but two exceptions were noted. For a low density, porous graphite chemi-mechanical erosion was observed at high temperature. For the highest density graphite the effect of surface reaction rate was observed at lower temperatures. Tests with four refractory carbides indicated that CO_2 and H_2O were the most damaging constituents and that HF was less damaging. For CO_2 and H_2O exposure the order of decreasing resistance of the carbides was found to be HfC, ZrC, TaC, and CbC. On exposure to HF the order of erosion resistance of the carbides was reversed. Author

N65-30044# Army Aviation Materiel Labs., Fort Eustis, Va.
POLYURETHANE AS EROSION RESISTANT MATERIAL FOR HELICOPTER ROTOR BLADES
E. Rouzee Givens May 1965 50 p
(USAAML-TR-65-39; AD-616128)

This report covers the use of PO 655 polyurethane material as an erosion resistant boot for the protection of helicopter rotor blades. Two adhesive systems were used with the polyurethane boots, and tests were conducted on CH-34 and UH-1B/D main rotor blades to evaluate the survivability of the material in an abrasive environment. Author

N65-30049# Boston Coll., Chestnut Hill, Mass.
COMPENDIUM OF MEASURED RHEO-OPTICAL PROPERTIES OF HYSOL 4485 Scientific Report No. 1
Ker C. Thomson, ed. Mar. 1965 83 p refs
(Contract AF 19(628)-212; ARPA Order 292; Proj. Vela-Uniform)
(AFCRL-65-358; AD-616391)

A measuring program was conducted with the aim of determining the complete rheo-optical characterization of a certain urethane rubber compound (HYSOL 4485) suitable for dynamic photo-visco-elastic studies. The shift curve and the master curve at 60° F are presented for both the Shear Storage Modulus and the Shear Loss Tangent. In determining the shear properties sinusoidal loading of specimens cut as hollow cylinders was used. Using a method designed originally by Selway and Brown the dynamic stress optic coefficient and the complex Youngs Modulus were measured at room temperature. The following tests were conducted in an atmosphere maintained at 70° F and 40% R.H. Youngs Modulus in creep was measured at two stress levels: 20.0 and 41.7 p.s.i. Dynamic stress-strain curves were determined using Volterra pendulum tests at two initial velocities 7.02 and 65.5 inches per second; and the static and dynamic stress optic coefficients were measured. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-29153# California Univ., Berkeley. Electronics Research Lab.
FUZZY SETS
L. A. Zadeh 16 Nov. 1964 20 p ref
(Grants AF-AFOSR-139-64; NSF GP-2413)
(Rept.-64-44; AD-608981)

A fuzzy set is a class of objects without a precisely defined criterion of membership. Such a set is characterized by a membership (characteristic) function which assigns to each object a grade of membership ranging between zero and one. The notions of inclusion, union, intersection, complement, convexity, etc., are extended to such sets, and various properties of these notions in the context of fuzzy sets are established. In particular, a separation theorem for convex fuzzy sets is proved without requiring that the fuzzy sets be disjoint. Author

N65-29187*# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
A LYAPUNOV METHOD FOR THE ESTIMATION OF STATISTICAL AVERAGES
W. M. Wonham Jun. 1965 21 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-65)
(NASA-CR-63946; TR-65-6) CFSTI: HC $1.00/MF $0.50 CSCL 12A

A randomly perturbed dynamical system is considered which is described by the equation

$$dx/dt = f(x) + G(x)\xi(t),\ t \geq 0, \qquad (1)$$

where x, f, are n-vectors, G is an $n \times n$ matrix and (t) is n-dimensional Gaussian white noise. Such equations arise in control theory, and the theory of random vibrations. In these applications it is of interest to know under what conditions the process $X = \{x(t),\ t \geq 0\}$ generated by (1) is stable, in the sense that X admits a unique invariant probability distribution. If X is stable then it is often desirable to estimate various stationary averages $\xi\{L(x)\}$, when these averages exist. In the present note a Lyapunov criterion is obtained for the existence (finiteness) of the stationary average $\xi\{L(x)\}$, where L is an arbitrary nonnegative function. This result is applied to show that algebraic moments of all orders exist when, in (1), G is bounded and the unperturbed system $dx/dt = f(x)$ is of the Lur'e type. The existence criterion is extended to yield an effective method of calculating an upper bound for $\xi\{L(x)\}$. The method is illustrated by an example from control theory. N.E.A.

N65-29226# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
DIFFERENTIAL INEQUALITIES AND ERROR BOUNDS
Johann Schröder Mar. 1965 63 p refs *Its* Mathematical Note No. 401
(DI-82-0424)

A unified theory on a certain type of inequalities for abstract linear operators and, in particular, for ordinary linear differential operators of the first, second, and fourth order is developed. The statements which involve these inequalities lead to a principle of error estimation. With a programmed procedure, approximate solutions and corresponding error bounds have been calculated for some examples of the second and fourth order. Author

N65-29457*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN INVARIANCE IN THE KRONIG-KRAMERS' RELATION
P. H. Fang and H. Oser (Natl. Bur. Standards, Washington, D. C.) [1964] 6 p refs Submitted for Publication
(NASA-TM-X-51904) CFSTI: HC $1.00/MF $0.50 CSCL 12A

From the restriction of the integration variable in the Kronig–Kramers' relation, an invariance property is established. This invariance relation is applied to establish the completeness of some representations used in the analysis of the relaxation dispersions. Author

N65-29492*# Iowa State Univ. of Science and Technology, Ames.
THE FOURIER SERIES OF GEGENBAUER'S FUNCTION
B. C. Carlson and W. H. Greiman [1964] 5 p refs Submitted for Publication
(Grant NsG-293)
(NASA-CR-59030) CFSTI: HC $1.00/MF $0.50 CSCL 12A

Presented is a theoretical analysis of the Fourier series of Gegenbauer's function $C_N^{\nu}(\cos\Theta)$. Analyzed are methods for the integration of Gegenbauer's function and deriving Fourier coefficients. S.C.W.

N65-29589# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOME ITERATIVE METHODS USING PARTIAL ORDER FOR SOLUTION OF NONLINEAR BOUNDARY VALUE PROBLEMS
H. S. Witsenhausen 14 May 1963 16 p refs
(Contract AF 19(628)-500)
(TN-1965-18; AD-616301)

This report surveys three iterative methods which may be used to numerically solve nonlinear boundary value problems. Author

N65-29620# RAND Corp., Santa Monica, Calif.
DRAGGING ALONG AND INVARIANT DIFFERENTIATION
Dominic G. B. Edelen Jun. 1965 17 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4546-PR; AD-615946)

A method whereby derivatives of general geometric fields can be evaluated at the deformed mass points in terms of quantities evaluated at the original undeformed mass points is developed. A general invariant derivative is defined in the course of the analysis. With this derivative and the Lie difference operator, relations between the dragged along invariant derivative and the invariant derivative of the dragged along field are derived. In all cases, the point transformations that give rise to the dragging along are considered as finite point transformations, and the exponential operator is used. Under restriction to infinitesimal deformations, the results reduce to the commutation relations between invariant differentiation and Lie differentiation. L.S.

N65-29683*# Massachusetts Inst. of Tech., Cambridge.
A MATRIX EQUATION ARISING IN STATISTICAL FILTER THEORY
James E. Potter Washington, NASA, Aug. 1965 32 p refs
(Grant NsG-254)
(NASA-CR-270) CFSTI: HC $2.00/MF $0.50 CSCL 12A

This report describes the behavior of the solutions of a matrix Riccati differential equation arising in statistical filtering and optimal control theory. The statistical problem leading to the Riccati equation is outlined. Definiteness, ordering and boundedness properties of the solutions of the general differential equation with time varying coefficients are derived. When the differential equation has constant coefficients, it is shown that under a set of physically reasonable conditions there is a unique steady state solution to which all other solutions converge at an exponential rate. Author

N65-29699# Arcon Corp., Lexington, Mass.
REAL TIME COMPUTATION OF CONSTRAINED LEAST SQUARES ESTIMATORS
Arthur Albert and Robert W. Sittler Jun. 1965 37 p refs
(Contract Nonr-4905(000))
(AD-616390)

Presented are results of a theoretical analysis which demonstrated that linear constraints can be treated like observations

with zero variance in least squares problems. It was also shown that a minor modification of a previously developed method for real time computations of unconstrained least squares estimators can be applied directly to the problem of weighted least squares estimation with constraints. S.C.W.

N65-29709# California Univ., Berkeley. Operations Research Center.
LAPLACE'S EQUATION AND NETWORK FLOWS
T. C. Hu. Feb. 1965 25 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-65-2; AD-615815)

This paper shows that partial differential equations may be a possible area of application of mathematical programming. The solution of Laplace's equation with Neumann's condition is shown to be a minimum cost network flow problem with cost proportional to the arc flow. An algorithm of solving minimum quadratic cost network flow is given. Author

N65-29882*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECT OF TRUNCATION ON TESTS OF HYPOTHESES FOR NORMAL POPULATIONS
Britain J. Williams (Ph.D. Thesis—Georgia Univ.) 26 May 1965 43 p refs
(NASA-TM-X-53272) CFSTI: HC $2.00/MF $0.50 CSCL 12A

The loss of power involved in using the usual tests of hypotheses for complete normal populations when, in fact, the population is a truncated normal one is examined. The technique employed is to obtain an asymptotic expansion of the distribution of sums of samples of size n drawn from a truncated normal population. An electronic computer is then employed to consider enough terms of this expansion to obtain the desired accuracy for the loss function, which is tabulated as a function of selected truncation points and sample sizes. Author

N65-29904# Stanford Research Inst., Menlo Park, Calif.
REPRESENTATIONS AND PRODUCTS OF TRANSITION GRAPHS Scientific Report No. 1
M. Yoeli and C. M. Ablow 1 Jun. 1965 23 p refs
(Contract AF 19(628)-5092)
(AFCRL-65-400; AD-463300)

A concise algebraic representation of isomorphism classes of directed graphs with no more than one edge issuing from a vertex is applied to find convenient formulas for the Cartesian products of such graphs. Author

N65-29963*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SELF-STARTING MULTISTEP METHODS FOR THE NUMERICAL INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS
William A. Mersman Washington, NASA, Jul. 1965 29 p refs
(NASA-TN-D-2936) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Classical, multistep, predictor–corrector procedures for the numerical integration of systems of ordinary differential equations are generalized to provide compatible, self-starting methods. Explicit algorithms and tables of numerical coefficients are presented. Author

N65-29964*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ON THE EFFICIENT USE OF PREDICTOR–CORRECTOR METHODS IN THE NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS
David Rodabaugh and James R. Wesson Washington, NASA, Aug. 1965 44 p refs
(NASA-TN-D-2946) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Basic interpolation formulas by Hermite can be used to generate large classes of correctors to be used in predictor–corrector processes for the numerical solution of differential equations. Conditions for the numerical stability of predictor–corrector processes are known. Only stable processes should be used in any solution requiring more than a few steps. Predictor–corrector methods are not self-starting; therefore, they are harder to program than starting processes. If programed so that there are few wasted applications of the corrector, however, then the predictor–corrector processes will have a significant computing time advantage over starting methods. Author

N65-30017# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
CONVEX PROGRAMMING AND OPTIMAL CONTROLS
A. A. Goldstein (Washington Univ.) Apr. 1965 10 p refs *Its* Mathematics Note
(DI-82-0430)

This paper will be concerned with the case of fuel-optimal linear controls. This problem will be reduced to the case of minimizing a convex function on E_n, and techniques of infinite convex programming will be applied. In the important case when the thrust magnitude is constrained, the convex function is continuously differentiable, and techniques of steepest descent may be applied. This approach has already been suggested by Neustadt–Paiewonsky. Author

N65-30052# New Mexico State Univ., University Park. Dept. of Mathematics.
A PARTIAL ANALYSIS OF GO
Edward O. Thorp and William E. Walden (Los Alamos Sci. Lab.) [1962] 12 p refs
(Contract W-7405-ENG-36; Grants NsF G-25058; AF-AFOSR-457-63)
(LADC-6372)

A game called Computer Go is defined. Computer Go differs from the game of Japanese Go only in that certain imprecisely defined conventions have been replaced by precise rules. Some general theorems on Computer Go are given, as well as a scheme for analyzing the game with the aid of a computer. Several reduced versions of Computer Go were analyzed and the resultant strategies are briefly described. Author

N65-30139# Measurement Analysis Corp., Los Angeles, Calif.
AN ANALYSIS OF AMPLITUDE PROBABILITY MEASUREMENTS, MARCH–DECEMBER 1964
G. P. Thrall Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1965 37 p refs
(Contract AF 33(615)-1418)
(MAC-403-01; FDL-TDR-64-116; AD-617611)

Techniques for measuring amplitude probabilities and probability densities are summarized and previous results on the statistical uncertainty of such measurements are reviewed. A rigorous mathematical model of probability measurements is derived. It is shown that unknown correlations in the parameters of the model make it impossible to develop explicit expression for the mean square estimation error. Results are presented of a computer simulation of amplitude probability estimates and comparisons are made between experimental and computed mean square errors. Author

N65-30160# Illinois Univ., Urbana. Dept. of Mathematics.
NOTES ON SPECTRAL THEORY

C. Ionescu Tulcea Dec. 1964 92 p refs
(Contract DA-31-124-ARO-D-288)
(AROD-5254-3; AD-617739)

Definitions and findings related to semi-spectral and spectral families of radon measures are given, and proofs for various applicable theorems are included. Scalar operators are discussed, and abstract valued measures associated with operators are considered. Scalar dilations and scalar extensions of operators on Banach spaces are related to spectral theory, and numerous proofs are included. Theorems implying that a subscalar operator is scalar are proven for both sparse and thin spectra. A bibliography is included. M.W.R.

N65-30164# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.

A PROGRAM OF RESEARCH ON THE APPLICATIONS OF ADAPTIVE SYSTEMS AND STATISTICAL DECISION THEORY TO THE PROBLEMS INVOLVED IN THE DETECTION OF ENEMY OPERATIONS Final Report, 1 Jan. 1963–31 Dec. 1964

Michael Goldberg, George R. Murray, Jr., and Dev K. Ray Feb. 1965 88 p refs *Its* Tech. Rept.-14
(Contract AF 19(628)-2435)
(AFCRL-65-104; AD-617612)

This report summarizes the research performed on two problems: (1) to create and investigate models for the entire search, detection, and decision system, useful for determining the operating conditions for overall system optimality; (2) to investigate the statistical and probabilistic problems associated with TV bandwidth reduction studies. Part I reports on several models of search and detection in which detection stations are fixed and the objects sought are free to move about. Consideration is particularly given to the nature of the noise field in which the system operates. The problem considered in where to place detection stations and how to process the incoming signal for one station alone and for the system as a whole. The nature of the mathematical difficulties encountered in reaching a solution to this problem is presented. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-29403*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MODELS FOR OBTAINING EFFECTS OF GROUND WINDS ON SPACE VEHICLES ERECTED ON THE LAUNCH PAD

Wilmer H. Reed, III [1964] 66 p refs Presented at the Conf. on the Role of Simulation in Space Technol., Blacksburg, Va., 17-21 Aug. 1964
(NASA-TM-X-54768) CFSTI: HC $3.00/MF $0.75 CSCL 04B

The paper describes how, through simulation with physical and mathematical models, the effects of ground winds on erected launch vehicles are being studied at the NASA, Langley Research Center. Experimental programs include both aeroelastically scaled models in wind tunnels and full-scale vehicles in natural winds. With the aid of a mathematical model having nonlinear aerodynamic damping, insight is gained which helps explain why in some instances the response at supercritical Reynolds numbers is a result of random forced excitation while in other instances is characterized by a self-excited periodic motion. Consideration is also given to the response of erected vehicles to atmospheric turbulence. It is shown that at the fundamental cantilever frequency of Saturn V class vehicles the gust velocities along the vehicle are essentially uncorrelated for separation distances greater than a few vehicle diameters. Calculations indicate that the response is significantly reduced when these spatial correlations of gusts are taken into account. Author

N65-29533 Library of Congress, Washington, D. C. Aerospace Technology Div.

DIURNAL AND SEASONAL VARIATIONS OF ALBEDO ON SOME NATURAL SURFACES IN THE ESTONIAN SSR

Kh. Tooming *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 70–109 refs Transl. into ENGLISH from Issled. po Fiz. Atm., Akad. Nauk Eston. SSR. Inst. Fiz i Astron. (Tartu), no. 2, 1960 p 115–163 (See N65-29525 18-13)

The albedo of natural formations is investigated as a characteristic of the radiation balance. A determination of the geographical distribution as one of the important problems in actinometry is also mentioned. A thermoelectric pyranometer was used for radiation measurement, and seasonal variations were noted. Comparative data on the difference in grass–snow surface albedo are presented. Variations in radiation balance due to time of day, climate, season crop, and plant physiology are also discussed. W.M.R.

N65-29534 Library of Congress, Washington, D. C. Aerospace Technology Div.

SPECTRAL RADIATION REGIME OF CORN CROPS AND COMPUTATION OF THE PHOTOSYNTHETICALLY ACTIVE RADIATION (PhAR)

Herbert Niilisk *In its* Optical and Thermal Properties of the Atmosphere 14 Jul. 1965 p 110–131 refs Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Tallinn), v. 13, no. 3, 1964 p 177–192 (See N65-29525 18-13)

The article describes the results of spectrophotometric investigation of the radiation field within a field of corn during a complex expedition to Yygev (Estonian SSR) in 1963. The average horizontal spectral streams of radiation at different levels within the planted field were obtained at five wave lengths. On the basis of these data the spectral absorption of the planting by layers was calculated. A method for calculating the photosynthetically active radiation according to spectral measurements is presented. Several examples of calculating the photosynthesis of the planted crop are presented. Author

N65-29673# Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.

AIR FORCE INTERIM SUPPLEMENTAL ATMOSPHERES TO 90 KILOMETERS Air Force Surveys in Geophysics No. 153

Allen E. Cole and Arthur J. Kantor Dec. 1963 44 p refs (AFCRL-63-936; AD-432073)

A mean annual Tropical (15° N) Atmosphere and January and July Subtropical (30° N), Midlatitude (45° N), Subarctic (60° N), and Arctic (75° N) Atmospheres have been prepared as supplements to the 1962 U.S. Standard Atmosphere; they provide information on latitudinal and seasonal changes in atmospheric structure up to 90 km. In addition to mean January and July atmospheres, cold and warm atmospheres, reflecting the two winter thermal regimes that have been observed in the arctic and subarctic stratosphere, are presented. Vertical temperature gradients for various altitude segments of each atmosphere are linear with geopotential height. Humidity is incorporated into the pressure and density computations

for the lowermost 10 km of each atmosphere. Figures and tables depict temperature, relative humidity, pressure, and density. Author

N65-29705# White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, NIKE-CAJUN NICAP/1 (ROUND NO. 012)
Gordon L. Dunaway Jul. 1965 29 p
(ERDA-325; AD-466440)

Meteorological data were collected over the White Sands Missile Range, New Mexico, for theoretical prediction of rocket impact of the Nike-Cajun NICAP/1. Data on wind components from the earth surface to 4000 feet, along with upper wind data and readings of temperature, pressure, and humidity from 4000 to 49000 feet, are presented in tabular form. Theoretical rocket performance values, consisting of payload, Coriolis displacement, second stage ignition, peak altitude and time, unit wind effect, and tower tilt effect, were calculated for the Nike-Cajun launch on June 10, 1965. These results are intended for use in future ballistic studies. J.M.D.

N65-29718*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FPS-16 RADAR/JIMSPHERE WIND DATA MEASURED AT THE EASTERN TEST RANGE
James R. Scoggins and Michael Susko 9 Jul. 1965 463 p refs
(NASA-TM-X-53290) CFSTI: HC $7.63/MF $2.25 CSCL 04B

This report presents wind measurements at Eastern Test Range employing the FPS-16 Radar/Jimsphere method. One hundred and twelve wind velocity profiles are presented. These measurements were made from November 1964 to May 1965. These data are not intended as a recommended statistical sample for structural and control system design criteria. They are presented to document this limited group of detailed wind profiles, and to provide a source for these data for use by other research organizations. Author

N65-29878# France. Direction de la Meteorologie Nationale, Paris.
POTENTIAL EVAPOTRANSPIRATION AND WATER DISTRIBUTION IN GUIANA [L'EVAPOTRANSPIRATION POTENTIELLE ET LE BILAN DE L'EAU EN GUYANE]
H. Madec Mar. 1963 20 p refs In FRENCH *Its* Monograph No. 39

Evapotranspiration values for various climatology and meteorology stations in French Guiana are tabulated month by month for the five year period 1956 to 1960. Evapotranspiration is the sum of the quantity of water evaporated by the sun and the quantity of water lost through vegetative transpiration. Trans. by J.M.D.

N65-30047# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
ARCTIC STRATOSPHERIC TEMPERATURES AND DENSITIES, APPENDIX IV Final Report
L. W. Engberg and A. D. Belmont 21 Aug. 1964 24 p refs
(Contract AF 19(628)-383)
(AFCRL-64-806, Addend.; AD-616320)

Using various extrapolation and interpolation techniques, serially complete sets of 20-km temperature data were derived for the arctic stations of St. Paul Island and Alert. Frequency distributions for the serially complete data were prepared and compared with those formed using observed temperatures only. The comparisons depicted only minor differences for St. Paul Island but significant differences for Alert. It was concluded that the cause of the bimodal form in any specific distribution is solely due to the relationship between the time of change in thermal conditions and the data period over which the distribution was formed. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-29377*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SEXTANT SIGHTING PERFORMANCE IN THE AMES MIDCOURSE NAVIGATION AND GUIDANCE SIMULATOR
Robert J. Randle and Bedford A. Lampkin [1964] 14 p refs Presented to NRC Comm. on Vision, Washington, 23–24 Apr. 1964
(NASA-TM-X-54709) CFSTI: HC $1.00/MF $0.50 CSCL 17G

The major features of the midcourse navigation and guidance simulator and the conduct of an exploratory study of sextant sighting performance in the simulated environment are described briefly. The visual scene is a 25° portion of the sky, including a simulated moon which is translatable in accordance with long-period vehicle-moon relative for typical trajectory. N.E.A.

N65-29584# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL NOISE OF MEASURING DEVICES AND LIMITING ACCURACY SELF-CONTAINED GUIDANCE OF A SPACE SHIP
A. A. Krasovskiy 25 May 1965 18 p refs Transl. into ENGLISH from RUSSIAN
(FTD-MT-65-130; AD-615861)

The limiting effects of thermal noise on the accuracy of inertial measuring systems and dispersion of trajectories of spaceships with automatic guidance systems was investigated. Presented is a theoretical analysis of open inertial systems. Comparative data on the limiting accuracy of inertial systems of angular orientation and the limiting accuracy of open navigational inertial systems are included. It was demonstrated that the limiting accuracy of an inertial system, which is determined by taking into account the thermal changes of orientation of the accelerometer and the disturbing accelerations, is essentially lower than the limiting accuracy during ideal orientation. It was further found that errors of the inertial system are almost completely triggered by the automatic guidance circuits and cause corresponding dispersion of spaceship trajectories. S.C.W.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-29204# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
EXPONENTIAL EXPERIMENTS AND NEUTRON MULTIPLICATION MEASUREMENTS WITH 1.25 WEIGHT % ENRICHED N-REACTOR FUEL ELEMENTS IN LIGHT WATER

C. L. Brown, R. C. Lloyd, S. R. Bierman, and E. D. Clayton
Mar. 1965 14 p refs
(Contract AT(45-1)-1830)
(BNWL-52)

Subcritical experiments have been performed with N-Reactor spike enriched fuel elements in light water to provide data for nuclear safety guidance. Exponential and neutron multiplication measurements were performed on 1.25 wt% enriched outer tubes (2.41 in. OD, 1.76 in. ID) and on tube-in-tube assemblies comprised of the outer tube and an 0.95 wt% enriched inner tube (1.25 in. OD, 0.44 in. ID) in each of four lattice pitches. Maximum bucklings were found to be 4680 microbucks for the outer tubes and 3900 microbucks for the tube-in-tube assemblies. Figures showing material buckling, critical mass, volume, slab thickness, and cylinder diameter as a function of water to fuel volume ratio are presented. Safe values for nuclear safety guidance are also presented. Pulsed neutron source measurements on two of the 1.25 wt% enriched outer tube lattices indicate the difference between delayed criticality and prompt criticality to be about five fuel columns for these lattices. Author

N65-29206# United Kingdom Atomic Energy Authority, Harwell (England). Safety Secretariat.
IRRADIATION OF SMALL SAMPLES IN THE REACTORS DIDO AND PLUTO
A. E. Truswell May 1965 23 p refs
(AERE-M-1563) HMSO: 3s 6d

The materials testing reactors DIDO and PLUTO are both equipped with facilities for irradiating small samples and this document provides some guidance on the safety aspects of such irradiations. Author

N65-29215# Atomic Energy Information Service, Frankfurt am Main (West Germany).
DIRECT CONVERSION OF NUCLEAR ENERGY INTO ELECTRIC ENERGY
Jan. 1965 43 p refs In ENGLISH and GERMAN *Its* Ser. C: Bibliographies; Section 15, No. 6
(AED-C-15-06)

A bibliography is presented of subjects closely associated with the direct conversion of nuclear energy into electric energy. Magnetic triodes, thermoelectric generators, reactors, magnetohydrodynamic generators, photogenerators, thermionic converters, solar conversion, thermophotovoltaic converters, and associated technology are included. E.E.B.

N65-29230# United Kingdom Atomic Energy Authority, Windscale (England). Reactor Group.
A METHOD OF LATTICE CALCULATION FOR GAS-COOLED GRAPHITE-MODERATED REACTORS
J. G. Tyror 1965 16 p refs
(TRG-754(W)) HMSO: 2s 6d

Lattice calculations involve solving for the neutron spectrum and associated reaction rates in an idealised cell of the reactor. The information thus obtained is then condensed into a form suitable for overall reactor calculations. This report describes a technique for obtaining approximate cell reaction rates. Although based to a large extent on fundamental nuclear data, it is nevertheless sufficiently simple and rapid to be useful in design calculations. The technique has been coded in FORTRAN II in the programme ARGOSY. Author

N65-29231# California Univ., Livermore. Lawrence Radiation Lab.
MEASUREMENT OF THE LIVERMORE POOL-TYPE REACTOR (LPTR) TRANSFER FUNCTION USING REACTOR OSCILLATION TECHNIQUES
Charles L. Cowan 30 Mar. 1965 28 p refs
(Contract W-7405-ENG-48)
(UCRL-12476) CFSTI: $2.00

The transfer function of the Livermore Pool Type Reactor was measured with the aid of a pile oscillator mechanism. A description of the oscillator construction is presented and the experimental transfer-function curves for phase lag and amplitude are indicated. The break frequency of the transfer function was determined from the measured curves and the ratio of the effective delayed neutron fraction to the effective neutron lifetime was found to be $\beta/l = 88 \pm 4\ \text{sec}^{-1}$. The transfer function was measured with both bare and cadmium-covered detectors. The frequency-response measurements were found to be identical for both detectors. Author

N65-29234# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
CORROSION OF EQUIPMENT IN THE HEAVY WATER COMPONENTS TEST REACTOR
J. Malvyn Mc Kibben Jun. 1965 32 p refs
(Contract AT(07-2)-1)
(DP-964) CFSTI: $2.00

The corrosion experience at the Heavy Water Components Test Reactor (HWCTR) is evaluated after three years of service. Within the moderator-coolant system, corrosion caused no operating problems or equipment failures. Adherent black oxide covered all mild steel surfaces in the moderator-coolant system, and no significant pitting was observed. Author

N65-29237# Los Alamos Scientific Lab., N. Mex.
INTEGRAL GAMMA AND NEUTRON MEASUREMENTS ON THE KIWI TNT
P. K. Lee and F. C. V. Worman 5 Jul. 1965 20 p refs
(Contract W-7405-ENG-36)
(LA-3304) CFSTI: $1.00

Gamma and neutron doses and integral neutron fluxes produced by the Kiwi TNT nuclear destruct event were documented. Dosimetry stations were positioned close to the reactor for measurement of prompt and fission product radiation. In addition, gamma doses resulting from the effluent cloud were monitored at distances out to 50 miles downwind with dosimeter films. Total rad doses of gamma and neutron radiation were 1.91×10^4 rads 50 feet from the reactor and decreased to 46.9 rads at 1,000 feet. Fission product gamma activity was selectively dispersed by the winds and produced an anisotropic gamma dose distribution even as close as 100 feet from the reactor. Gamma doses downwind from the reactor were 250 mR at 8,000 feet, 330 mR at 16,000 ft, 150 mR at 6 miles, and 10 mR at 12 miles. Author

N65-29244# Los Alamos Scientific Lab., N. Mex.
HIGH-TEMPERATURE REACTOR CORE THERMOCOUPLE EXPERIMENTS
W. R. Prince and W. L. Sibbitt 8 Jul. 1965 20 p
(Contract W-7405-ENG-36)
(LA-3336-MS) CFSTI: $1.00

The combination of environment and required thermocouple location imposes definite limitations as to the temperature level and accuracy of thermocouple measurements in the Kiwi reactor cores. The thermocouples are required to operate in a hostile environment deep in the reactor core: in hot hydrogen, in direct contact with graphite, and under intense nuclear radiation. Experimental measurements of temperatures up to 4800° F using both prototype and actual reactor hardware thermocouples have been made under simulated reactor environment (no irradiation) in an electric resistance furnace. Results have indicated that the upper limit for the conventional operation of thermocouples in graphite reactor

cores is restricted by the metal-carbon eutectic melting of the sheath. Errors in the indicated signal, depending upon the type and geometry of the thermocouple and length exposed to high temperature, can be as much as 1500° F at a true temperature of 4500° F due to excessive leakage current between the wires. An acceptable thermocouple, as determined by maximum allowable operating temperature and lowest signal error, was a 1/8-inch-diameter tantalum sheathed thermocouple having swaged beryllium oxide insulators and 20-mil W-W26Re wires. Author

N65-29247# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

BURNUP DETERMINATION OF NUCLEAR FUELS Project Report, 1 Jan.–31 Mar. 1965

W. J. Maeck and J. E. Rein, ed. Jun. 1965 41 p refs

(Contract AT(10-1)-205)

(IDO-14660) CFSTI: $2.00

Uranium 235 thermal fission yields for many stable and long-lived fission products were measured. A capsule containing a weighed quantity of highly enriched U^{235}, irradiated to 11.5 atm% fission, was dissolved and analyzed for the number of atoms of each uranium isotope and for the number of atoms of various stable and long-lived fission product nuclides. From these data, the capture-to-fission ratio and absolute fission yields were determined. Also, the conditions established for the mass spectrometric analysis of krypton, xenon, and the lanthanides are described. Separation methods were developed for the alkali metals, the alkaline earth metals, and ruthenium applicable to irradiated uranium and plutonium samples. These methods are designed for subsequent isotope dilution mass analysis to establish absolute fission yields. A separation method for individual lanthanides applicable to irradiated plutonium samples which contain relatively high amounts of americium and curium is included. E.E.B.

N65-29349# Battelle Memorial Inst., Columbus, Ohio.

PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING APRIL, 1965

Russell W. Dayton and Stan J. Paprocki 1 May 1965 45 p refs

(Contract W-7405-ENG-92)

(BMI-1723(Del.)) CFSTI: $1.00

Reactor research relating to civilian applications is reported. Included are an irradiation surveillance program on type 347 stainless steel, interstitial behavior in alloys of the chromium rhenium type, densification of graphite by unconventional fabrication techniques, roles of surface chemistry and interatomic forces in solid state pressure bonding, examination of the steam generator from the pressurized water reactor, studies of PuN and its alloys, BeO–ThO_2–PuO_2 fuel development, high burnup effects on UO_2–CeO_2 and UO_2–ZrO_2 fuels, thermal property measurements of ZrO_2 base fuels, thermal stability of ZrO_2 base fuels, radiation induced organometallic compound formation, studies on fuel particle, carbon coating, in-pile irradiation, postirradiation, and fission product diffusion, postirradiation capsule examination, and evaluation of type 347 stainless steel for gas cooled reactor application. R.N.A.

N65-29380*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STOPPING CROSS SECTION OF LOW ATOMIC NUMBER MATERIALS FOR He^+, 65–180 keV

R. Dale Moorhead [1963] 23 p refs Submitted for Publication

(NASA-TM-X-51979) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Stopping cross sections were measured for H_1^+ in carbon and for He^+ in carbon, aluminum, and chromium over the energy range of 65 to 180 keV. Layers of the stopping materials were evaporated *in vacuo* onto a gold-plated quartz crystal and their areal densities were computed from the shift in the resonant frequency of the crystal. The energy lost by the ions in the stopping material was determined by measuring the energy of the scattered ions. Experimental results show a divergence from available theory above 80 keV. Author

N65-29443*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NON-CHEMICAL PROPULSION

John C. Evvard [1964] 68 p Presented at 7th Ann. Missile and Space Technol. Inst., Conn. Univ., Storrs, 22 Jul. 1964

(NASA-TM-X-31993) CFSTI: HC $3.00/MF $0.75 CSCL 21F

The performance of nuclear and chemical rockets are compared, and an evaluation is made of such nonchemical space propulsion sources as the nuclear and the solar-heated hydrogen rockets; electric propulsion; and the gaseous core nuclear, the thermonuclear, and the photon rockets. It was pointed out that although nuclear engines are feasible to safely boost space payloads into orbit, probable political repercussions may retard their use. The problems associated with electric propulsion systems are discussed, with the major hurdle being the development of systems that can provide power with low specific weights and high reliability for manned interplanetary flights. The possibilities offered by the solar-heated hydrogen, gaseous core nuclear, thermonuclear, and photon rockets are mentioned, with the need of further research stressed. The ORION concept is discussed; however, its use would be restricted to large payloads involving requirements for substantial velocity increments. The feasibility of a radioisotope photon rocket, and an antigravity propulsion device are also mentioned. M.G.J.

N65-29466*# Hawaii Univ., Honolulu. Dept. of Physics.

PHOTOIONIZATION YIELD AND ABSORPTION COEFFICIENT OF XENON IN THE REGION 860–1022°Å

F. M. Matsunaga, R. S. Jackson, and K. Watanabe (Stanford Res. Inst.) [1964] 14 p refs

(Grant NsG-328; Contract AF 19(628)-265)

(NASA-CR-58456) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Absorption coefficient and absolute photoionization yield of xenon gas have been measured by photoelectric methods with 0.2 Å bandwidth in the 860–1022 Å region. Ionization yields were obtained with a platinum detector calibrated against a calibrated thermocouple. A yield value of unity was obtained throughout this region which includes preionized Rydberg lines. The absorption coefficient at most wavelengths fell between the spread of previous values. Author

N65-29474*# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.

MOLECULAR ORBITAL THEORY OF VANADIUM IN THE RUTILE STRUCTURE CRYSTALS SnO_2, TiO_2 AND GeO_2

Sophocles Karavelas and Chihiro Kikuchi Jul. 1964 127 p refs *Its* Rept.-04381-7-T

(Grant NsG-115-61)

(NASA-CR-58458) CFSTI: HC $4.00/MF $1.00 CSCL 07D

Observed electron spin resonance spectra in the rutile type crystals of SnO_2, TiO_2, and GeO_2, with vanadium as an impurity, are investigated. Molecular orbital theory is used in a semiempirical calculation with the linear combination of atomic orbitals approximation (LCAO). The crystal region consisting of the vanadium ion and six ligand oxygen ions is selected. Atomic orbitals used in the LCAO approximation include 9 vanadium 3d, 4s, 4p orbitals, and 24 ligand oxygen 2s, 2p orbitals. Hybrid oxygen orbitals are constructed and it is shown how group theory can simplify the secular equation and formulate the selection rules. Group theory use requires the construction of LCAO transforming according to the irreducible

representations of the D_{2h} group and they are constructed by the method of projection operators. The group overlap integrals are calculated and the valence state ionization potentials (VSIP) of the oxygen and vanadium ions are estimated. The reduced secular equations are solved using the VSIP as parameters. Charge self-consistency is not adequate in selecting the best solutions. The detailed charge distribution among the orbitals must show self-consistency. R.N.A.

N65-29479*# National Aeronautics and Space Administration. Lesiw Research Center, Cleveland, Ohio.
APPLICATIONS OF LOW-POWER NUCLEAR ROCKETS
Frank E. Rom Washington, NASA [1964] 17 p refs Presented at the Second Lecture Ser. on Nucl. and Elec. Rocket Propulsion, AGARD, Brussels, 28 Sep.–3 Oct. 1964
(NASA-TM-X-52048) CFSTI: HC $1.00/MF $0.50 CSCL 18N

Large velocity increments necessary to achieve scientific missions of interest require the use of lightweight nuclear powerplants since all chemical systems cannot accomplish many missions which the nuclear systems can. This paper points out the velocity requirements of low-power missions and discusses the performance that would be attainable with the use of these low-power missions on booster systems that are currently developed or being developed. N.E.A.

N65-29480*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FAST AND MODERATED LOW-POWER, LIGHTWEIGHT REACTORS FOR NUCLEAR ROCKET PROPULSION
Frank E. Rom Washington, NASA, 1964 75 p refs Presented at 2d Lecture Ser. on Nucl. and Elec. Rocket Propulsion, AGARD, Brussels, 28 Sep.–3 Oct. 1964
(NASA-TM-X-52047) CFSTI: HC $3.00/MF $0.75 CSCL 21F

Fundamental reactor types are described, the properties of high temperature materials available for nuclear rocket reactor applications are examined, and various reactor concepts suitable for low power lightweight nuclear rocket powerplants are presented. The study showed that it is possible to conceive of lightweight nuclear rocket powerplants suitable for low power applications. In examining the basic properties of the refractory materials such as melting point, vaporization rate, thermal stress resistance, and strength, tungsten was found to offer the greatest potential for both fast and thermal reactors. R.N.A.

N65-29549# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MARCH, 1965
Russell W. Dayton and Stan J. Paprocki 1 Apr. 1965 47 p
(Contract W-7405-ENG-92)
(BMI-1721 (Del)) CFSTI: $1.00

Progress is reported on nuclear reactor materials, fuels, radioactive isotopes, and reactor technology. Among the specific investigations were the quantitative studies on the aging kinetics of nitrogen in chromium-35 atm% rhenium. Changes in electrical resistivity and internal friction were measured for wires quenched from 1150° C and aged various lengths of time at 650° and 700° C. Both resistivity and internal friction aged out progressively over about the same period of time. A discontinuity in the resistivity aging profile, tentatively associated with the effect of coherency strains during precipitation, was observed at both temperatures. A series of 1-chloro compounds was irradiated under conditions which give high yields with 1-bromobutane. The chloro derivatives were very unreactive, giving no more than a trace of product even at high doses. In contrast, 1-bromopentane gave an even higher yield than 1-bromo-butane at the same dose and dose rate. E.E.B.

N65-29601# General Motors Corp., Indianapolis, Ind. Allison Div.
MCR SMALL SOURCE EXPERIMENTS
R. S. Strzelecki and J. Celnik 3 May 1965 113 p refs Prepared under subcontract by United Nuclear Corp.
(Contract AT(30-1)-3078)
(GMAD-3078-28; EDR-4195)

Military Compact Reactor (MCR) shield design analytical techniques and cross sections were tested by comparing calculations with measurements for experiments emphasizing the secondary gamma-ray production in specific test materials. Measurements were made with a gamma-ray spectrometer behind a configuration consisting of a layer of gamma-ray shielding material (the test sample) adjacent to a small polonium-beryllium (Po-Be) neutron source, followed by neutron and gamma-ray shielding material to reduce extraneous detector response. Calculations of spectrometer response for samples of lead, tungsten, and titanium hydride were performed with a three-dimensional Monte Carlo code, derived from the one-dimensional Monte Carlo codes used in the MCR preliminary design shield analysis. The calculations generally gave satisfactory predictions of the measurements. Differences between the measured and calculated responses indicated that some of the cross sections used, particularly for lead, were low and should be revised. It is estimated that these revisions would lead to a 10% increase in predicted total dose rate external to the MCR shield. Author

N65-29688# Atomics International, Canoga Park, Calif.
AEROSPACE SAFETY PROGRAM. SAFE DISPOSAL OF SNAP REACTORS
R. L. Detterman, A. Weitzberg, and C. A. Willis [1965] 43 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11353) CFSTI: $2.00

Methods for safely disposing of SNAP reactors after space operation are evaluated. There are three principles which may be employed: decay, dilution, and recovery. Three basic methods have evolved for implementing the disposal principles; the basic methods are: (1) boost to a long-lived orbit, (2) destruct, and (3) controlled reentry. The value of each of the methods depends on the characteristics of the reactor. Combinations of these methods for the short orbit case are considered and several systems are found to be promising. For the long orbit case, it is found that a reliable end-of-life shutdown device coupled with intrinsic subcriticality effectively eliminates all safety problems for these missions. It is concluded that: (1) an effective destruct device should be developed, (2) practical aspects of boost and deboost systems should be investigated, (3) data should be obtained and used to provide a more realistic evaluation of fallout hazards, and (4) intact reentry systems appear undesirable. Author

N65-29713# European Atomic Energy Community, Brussels (Belgium).
ORESTE T. I.-STATISTICAL CODE FOR THE HYDRAULIC AND THERMAL STUDY OF FUEL ELEMENTS
B. Chambaud, J. C. De Bruyn, and M. F. Jamet Mar. 1965 136 p refs
(EUR-2289.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 150 Belg. Fr.

The determination of a reactor's performance takes into account the natural limits of the use of some components, for instance: maximum admissible temperatures for the coolant, the sheathing or the fuel. Practically, to take into account uncertainty margins related to each value which appears in the determination of the performances, we introduce safety factors

which lower the reactor behaviour. ORESTE T.I., a Fortran Code on an IBM 7090 computer, calculates the performances of a reactor channel, taking into account statistical margins of uncertainty. Author

N65-29715# Geoscience, Ltd., La Jolla, Calif.
HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS Annual Technical Report, 1 Sep. 1963–31 Aug. 1964
H. F. Poppendiek et al [1964] 159 p refs
(Contract AT(04-3)-409)
(GLR-27; SAN-409-12)

During the past year Geoscience investigated high-temperature liquid metal heat and momentum transfer processes. The program was composed of analytical and experimental liquid metal boiling and condensing studies with emphasis on high gravity or helical flow in the high vapor quality and superheated regions. Liquid metal research results are presented in the areas of (1) forced flow liquid metal boiling, (2) droplet vaporization, (3) forced flow liquid metal condensation, (4) forced flow Freon boiling, (5) interpretation of liquid metal data in the literature, (6) thermodynamic properties of alkali metal vapors, and (7) heat transfer influences on reactor kinetics. From the research results, design criteria which are applicable to the SNAP Project are being developed so that nuclear reactor and heat exchange performance can be predicted. N.E.A.

N65-29796# Space Technology Labs., Inc., Redondo Beach, Calif.
KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS Annual Summary Report
C. T. Molloy, L. G. Neal, N. C. Pate, L. B. Wentz, and R. W. Wright 30 Dec. 1964 143 p refs
(Contract AT(04-3)-372)
(STL-372-13) CFSTI: $4.00

Experiments were conducted to further the kinetic understanding of heterogeneous water reactors. Data from in-pile capsule measurements of transient steam void formation, and pressures in millisecond power transients are presented with the objective of explaining features which are important in reactor shutdown. Energy transfer in a destructive pressure transient is analyzed; a laboratory experiment on thermal pressure generation is described; and the hydrodynamic stability of a rod bundle at atmospheric pressure, and distributional effects in two-phase slip models are discussed. Also presented is an analysis of the motion of a rapidly expanding bubble near a wall, and the effects of the compressibility of a hydrostatic water column on the modeling of void formation in a reactor power excursion. L.S.

N65-29827# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
BURNUP PHYSICS OF HETEROGENEOUS REACTOR LATTICES
Claude G. Poncelet (Ph.D. Thesis—N. Carolina State Univ.) Jun. 1965 185 p refs
(Contract AT(30-1)-3017)
(WCAP-6069)

A method has been developed for the calculation of fuel burnup in a heterogeneous reactor lattice cell. The method accounts for all non-linearities and mutual connections in the system of equations consisting of the transport equation for the flux and the isotopic depletion equations. The model is based on a multi-energy group calculation based on the integral transport equation in the thermal energy range and the P-1 approximation in the epithermal and fast energy ranges. The spatial distribution of epithermal resonance reaction rates is calculated by the Monte Carlo technique. The thermal energy cut off is 1.855 ev. The method consists in calculating the neutron flux in space and energy as a function of time, and introducing this time dependent flux into the isotopic depletion equation to obtain the fuel composition as a function of time. The solution of these equations has been put into the form of matrices, the elements of which are isotopic reaction rates or functions of reaction rates based on unit isotopic concentrations. The method has been programmed in the FORTRAN IV language for the IBM-7094 computer. Author

N65-29850# Atomics International, Canoga Park, Calif.
200-Mwe PROTOTYPE LARGE SGR—REACTOR STRUCTURE DESIGN AND EVALUATION
D. R. Anderson and K. W. Foster, ed. [1965] 249 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11314) CFSTI: $6.00

This document describes the expected operating environment for the 30-yr plant life, treats the steady-state and transient effects on the reactor structure, provides the basis for selection of materials, summarizes results of the mechanical-structural analysis, and describes calandria leak detection and remote maintenance techniques. The results of these studies indicate a highly reliable reactor, conservatively designed to fulfill operating requirements of the 200-Mwe SGR Prototype. Author

N65-29857# Argonne National Lab., Ill. Metallurgy Div.
THE MANUFACTURE OF GLASS-BONDED FUELS FOR DOPPLER COEFFICIENT MEASUREMENT
J. E. Ayer, A. G. Hins, D. E. White, D. C. Carpenter, and C. F. Konicek Mar. 1965 52 p refs
(Contract W-31-109-ENG-38)
(ANL-6995) CFSTI: $2.00

This report describes procedures used to manufacture and assemble glass-bonded, plutonium-containing fuels for Doppler coefficient measurement. Seventeen acceptable fuel rods containing $(U–Pu)O_2$ or PuO_2 pellets were made. The pellets, which were required to have low (about 70% theoretical) density, were held together by a silicate bond. The pellets were made by milling the oxide; compacting, granulating, and sintering the milled product; pressing pellets from "fired" granules treated with Na_2SiO_3; and sintering the pellets. The pellets were loaded into capsules, the capsules were decontaminated, welded closed, leak tested at room temperature and at 1000°C, and radiographed. Author

N65-29967*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
STUDY OF NUCLEAR BRAYTON CYCLE POWER SYSTEM
S. I. Freedman 5 Aug. 1965 202 p refs
(Contract NASw-980)
(NASA-CR-54397; GE-65SD4251) CFSTI: HC $6.00/MF $1.25
CSCL 10B

A parametric analysis and system optimization was made of reactor heated Brayton cycle space powerplants in the 50 to 200 KWe range. Models of gas and liquid-metal cooled reactors, shields, turbomachinery, heat exchangers, piping, and gas and liquid-metal filled radiators were synthesized. Application to manned and unmanned missions enabled evaluations to be made of reactors and shield configurations and system integration influences over a wide range of requirements. Turbomachinery performance was based on the efficiencies of the NASA/Lewis two-shaft solar Brayton system. Dependence of optimized system specific weight on shield requirements, turbine inlet temperature and power rating were determined. Author

N65-29975# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria).
BURN-UP ANALYSIS OF NUCLEAR FUELS WITH HELP OF MASS SPECTROGRAPHIC METHODS [ABRANDBESTIMMUNG VON KERNBRENNSTOFFEN MIT HILFE MASSENSPEKTROMETRISCHER METHODEN]
F. P. Viehbock [1964] 15 p refs In GERMAN Presented at the Fall Conf. of Osterreichischenphysik. Ges., Graz, 1964 Submitted for Publication
(SGAE-PH-11)

The precision and accuracy of non-destructive mass spectrometric methods for analyzing nuclear fuels and fission products is discussed, and a comparison of the accuracy of the methods is tabulated. A burn-up analysis of coated uranium particles, followed by mass spectrometric determination of the combustion products is discussed. A picture of the mass spectrometer used, a schematic diagram of the ionizing source, and a mass spectrum of a test analysis are shown. Transl. by L.S.

N65-29979# Atomics International, Canoga Park, Calif.
ANALYSIS OF NEUTRON TRANSMISSION THROUGH SLABS OF LITHIUM HYDRIDE
R. S. Hubner 4 Jan. 1965 14 p refs
(NAA-SR-10853)

The results of the analyses of the ORNL Tower Shielding experiments on fast neutron transmission through lithium hydride slabs are presented and compared to the experimental data. Satisfactory agreement in the scattered dose is noted in all cases with the maximum deviation at the 30 inch thickness being only 25%. The calculated transmitted spectra and neutron collision doses are presented. The Monte Carlo techniques used in the analysis were described in NAA-SR-9418; modifications to these methods are presented in the appendix.
Author

N65-30018# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Jun. 1965
R. M. Adams and A. Glassner 30 Jul. 1965
(Contract W-31-109-ENG-38)
(ANL-7071) CFSTI: $3.00

Progress is reported on the development of liquid metal cooled reactors, general reactor technology, advanced reactor research, and nuclear safety. Specific areas of development include the Experimental Breeder Reactor II; the Fast Reactor Test Facility, fast reactor systems and concepts; general fast reactor physics, fuel development, and fuel reprocessing development; experimental reactor and nuclear physics; theoretical reactor physics; high temperature materials; other reactor fuels and materials development; engineering development; chemical separations; plutonium recycle reactors; advanced research reactor; energy conversion systems; reactor kinetics; the Transient Reactor Test Facility; and chemical and associated energy transfer problems in reactor safety. R.N.A.

N65-30176# Atomics International, Canoga Park, Calif.
ACCEPTANCE TEST OF PSM-3 DC CONDUCTION NaK PUMP (MRP)
W. H. Wickes 2 Sep. 1964 7 p
(NAA-SR-Memo-10401)

The DC conduction NaK pump was installed in recirculating loop and operating at 75° F. and 1000° F to determine compliance with design specification. Performance is mapped over the range of 0–20 gpm flow and 0.2 to 5.0 psi discharge pressure in accordance with Test Specification NA0204-010. At the design condition of 71 lb/min flow and 3 psi discharge pressure, power required was 885 amp. Magnetic flux in throat is 3800 Gauss. The pump met all design requirements and was delivered for assembly into the PSM-3 system. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-29155# RAND Corp., Santa Monica, Calif.
NUMERICAL RESULTS FOR THE AUXILIARY EQUATION OF RADIATIVE TRANSFER
R. Bellman, H. Kagiwada, and R. Kalaba Apr. 1965 26 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4572-PR; AD-614636)

A basic problem in astrophysics, meteorology and neutron transport theory is the determination of the internal intensity produced when uniform parallel rays illuminate a slab of finite thickness which both absorbs and scatters radiation isotropically. One approach to this problem is through the intermediate step of determining the source function which represents the rate of production of scattered radiation per unit volume per unit solid angle as a function of the depth below the top surface. Ordinarily this function is characterized as the solution of a singular integral equation, which presents difficulties from the numerical view-point. In earlier memoranda the authors derived other differential integral equations for the source function viewed as a function of the thickness of the slab. In this memorandum they present the results of extensive calculations of source functions in both graphical and tabular form. Author

N65-29201# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MULTIPLYING THE ANGLE OF REFRACTION OF A LIGHT BEAM IN REFRACTOMETRY
S. S. Palley, M. A. Zhuravlev et al 28 Apr. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 158702 (Appl. No. 776588/23-4, 12 Nov. 1963) 2 p
(FTD-TT-64-1288/1+2; AD-615294)

The object of the invention is a device for the multiplication of the angle of refraction of a light beam in refractometry, which is distinguished by the fact that for the purpose of simplifying the design and increasing the precision of the measurements it is built in the form of an elastic suspension, with a reflector fastened on it, and consists of two parts of different section, the end with the lesser section of which is connected with a shaft with a scale and reversing motor, and the end with the greater section being fastened to the movable support with scales. Author

N65-29256# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.
AN INTEGRAL REPRESENTATION FOR MAXWELL'S EQUATIONS WITH ARBITRARY TIME DEPENDENCE Scientific Report No. 1
David C. Stickler 15 May 1965 15 p refs *Its* Rept.-1793-1
(Contract AF 19(628)-4002)
(AFCRL-65-342; AD-466181)

Integral expressions are presented for the fields interior to a source-free homogeneous volume in terms of the tangential electric and magnetic fields on the surface of the volume. Although this integral representation is available by straightforward methods, to the best of the author's knowledge, it has

not appeared before, and it is much simpler than some. The representation also constitutes a statement of Huygen's principle for electromagnetic waves in the sense that the contribution from each surface element is itself a solution of Maxwell's equations. The relationships are also pointed out between the present representation and previous ones. Author

N65-29278# Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF THE EARTHS GRAVITATION ON THE FREQUENCY OF TUNING FORKS [DER EINFLUSS DER ERDSCHWERE AUF DIE FREQUENZ VON STIMMGABELN]
A. Karolus and K. Thiesburger Min. of Aviation, May 1965 12 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 14, no. 8, 1962 p 462–465
(RAE-LIB-TRANS-1109)

A half-empirical theory is given on the effect of the earth's gravitational field on the frequency of bars and tuning forks fixed at one end. The relative frequency difference in the two parallel and vertically opposite positions of a tuning fork is given by

$$\Omega = C \frac{g}{\omega^2 L} \qquad (12)$$

$\omega = 2\pi f$ = natural frequency of tuning fork in Hz, L = length of prongs in cm, g = gravitational acceleration in cm-sec^{-2} The form factor C has the value 1.54 for forks whose prongs have a constant cross-section over the whole length. For forks with added masses the values of C are smaller. Experimental proof of equation (12) gives C = 1.40 as the correct value here. The values for Ω, measured on numerous tuning forks, differ from the theoretical result by 10% at most. During rotation of the fork about an axis perpendicular to the fork axis, the frequency variation $\Omega(\phi)$ is accurately sinusoidal for one definite position of the fork with respect to the direction of rotation. For other positions the frequency variation is somewhat distorted by the effect of disturbances. Author

N65-29400*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ROTOR–STATOR INTERACTION NOISE STUDIES OF A SINGLE-STAGE AXIAL-FLOW RESEARCH COMPRESSOR
William L. Copeland and John L. Crigler [1964] 16 p refs Presented at the 68th Meeting of the Acoust. Soc. of Am., Austin, Tex., 21–24 Oct. 1964
(NASA-TM-X-54777) CSCL 20A

This paper gives some experimental results of a noise study of a single-stage axial-flow research compressor. The objective of the study was to investigate the radiation patterns in the far field of the noise due to rotor-stator interactions. The data are presented in the form of radiation patterns and frequency spectra. The radiation patterns compare favorably with results calculated by the method of Tyler and Sofrin. These data show how the radiation patterns are affected by the relative number of rotor blades and stator vanes. Several tests were run to obtain the optimum spacing between the rotor and stator vanes for best results. An appreciable reduction in sound pressure level was observed for the fundamental blade passage frequency and the characteristic radiation lobe amplitudes have been markedly reduced due to increased rotor-stator spacing. Author

N65-29494*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERFERENCE AND INTERFEROMETRY
M. P. Thekaekara [1961] 19 p refs Submitted for Publication
(NASA-TM-X-51981) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Interference and interferometry are defined and discussed. Young's classic experiment in interference is described, and interference theory and the application of its effects are discussed. Descriptions and applications of the Michelson and Fabry–Perot interferometers are presented. R.N.A.

N65-29563# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.
THE COMPLEX SPACE-TIME MODEL
A. Das [1965] 61 p refs
(Grant DA-AROD-124-G-602)
(AROD-223-60; AD-463054)

CONTENTS:
1. COMPLEX SPACE-TIME AND CLASSICAL FIELD THEORY 21 p refs (See N65-29564 18-23)
2. THE QUANTIZED COMPLEX SPACE-TIME AND QUANTUM THEORY OF FREE FIELDS 29 p refs (See N65-29565 18-23)
3. COMPLEX SPACE-TIME AND GEOMETRIZATION OF ELECTROMAGNETISM 9 p refs (See N65-29566 18-23)

N65-29564 Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.
COMPLEX SPACE-TIME AND CLASSICAL FIELD THEORY
In its Complex Space-Time Model [1965] 21 p refs (See N65-29563 18-23)

This is the first of the series of three papers which introduces complex space-time to describe physical phenomena. The objective of this generalization is two fold, firstly to geometrize gauge transformations and electromagnetic fields and secondly to quantize space-time in order to remove serious divergences from the field theory. In this paper classical fields are discussed in complex space-time with a view of subsequent generalization to quantum field theory in quantized space-time. Author

N65-29565 Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.
THE QUANTIZED COMPLEX SPACE-TIME AND QUANTUM THEORY OF FREE FIELDS
In its Complex Space-Time Model [1965] 29 p refs (See N65-29563 18-23)

In this paper a covariant quantization of complex space-time is proposed. As a consequence of this quantization each of the four real coordinates can take discrete values and furthermore measurements of these coordinates are non-interfering with each other. Next the general theory of quantized free fields is developed in the background of quantized space-time. As an example the case of complex scalar field has been dealt with and it is found that the resulting Green's functions are non-singular. Author

N65-29566 Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.
COMPLEX SPACE-TIME AND GEOMETRIZATION OF ELECTROMAGNETISM
In its Complex Space-Time Model [1965] 9 p refs (See N65-29563 18-23)

It is shown here that if we demand the covariance under general circular transformations (rotations in complex planes) the electromagnetic potentials can be geometrized as the affine connections necessary for such covariance. The geodesic hypothesis yields the Lorentz-equation of motion with an interesting correction term. Author

N65-29585# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMAL PROGRAM OF CORRECTION IN THE PROBLEM OF MOTION IN A GRAVITATIONAL FIELD WITH LIMITED POWER
V. V. Tokarev 20 May 1965 12 p refs Transl. into ENGLISH from Russian
(FTD-MT-65-131; AD-615862)

The problem of maximum payload delivery for a propulsion system of limited power is considered, taking into account correction of the trajectory. For an ideally controllable rocket engine, the problem is reduced to finding the minimum of mathematical expectation of the square of rocket acceleration. Realization errors in the program for rocket acceleration, and deviations from the calculated trajectory are discussed. The problem of optimal correction is formulated such that before realization of the trajectory, optimum relationships and optimum programs of rocket acceleration are selected which will ensure a payload maximum. It was found that optimal distribution of correction moments in the case of exact measurements obeys formulas of geometric progression and becomes denser toward the end of the trajectory. L.S.

N65-29723*# Space Technology Labs., Inc., Redondo Beach, Calif.
SPRING SEPARATION OF SPACECRAFT
D. H. Mitchell and G. D. Palmer Apr. 1963 32 p refs
(Contract NAS5-899)
(NASA-CR-64009; EM-13-10; STL-2319-6038-TU-000) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The detailed equations of motion for a spacecraft separating from a final rocket stage or another spacecraft by means of separation springs have been derived and programmed for solution on the IBM 7090 digital computer. This report shows how the equations were derived, which parameters are significant, and how the program can be used to compute tipoff errors for actual spring separation system design. Author

N65-29813*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE REFLECTION OF SOFT X-RAYS BY POLISHED SURFACES OF GLASS AND STEEL
James H. Underwood May 1965 24 p refs
(NASA-TM-X-55267; X-614-65-202) CFSTI: HC $1.00/MF $0.50 CSCL 20F

Using a vacuum reflectometer which employs a mica crystal monochromator and a proportional counter detector, measurements of the efficiency of reflection of soft X-rays by optical flats of "Pyrex" glass and stainless steel were made at a number of wavelengths in the region 5–16 Å. Values of the refractive index and mass absorption coefficient of the media were obtained from the curves of reflection efficiency versus glancing angle, and compared with predicted values. A disagreement between theory and experiment was found, which could be attributed to microscopic surface roughness, and a reduced surface electron density. Author

N65-30061# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
RELATIVE INTENSITIES OF X-RAY REFLECTIONS OF VARIOUS ORDERS FOR TEN CRYSTAL MONOCHROMATORS Technical Report No. 32
Pol Duwez Jan. 1965 22 p
(Contract AT(04-3)-221)
(CALT-221-7)

The relative intensities reflected from several crystals at various reflection orders are under investigation. Quartz and silicon were selected from a number of crystals by checking the accuracy of the (hkl) cut by means of a rocking curve. Cleavage planes were used for all other crystals. Assuming that the intensities measured from the first order reflection of the ten crystals represented a reasonable value for crystals of average quality, all the crystals were compared to find out which crystal, and which reflection order gave useful intensities within a given angular range. It was concluded that all of the strongest reflections of the various crystals were concentrated at the low end of the 2θ scale. However, several relatively strong reflections at higher Bragg angles may serve a useful purpose in the design of instruments involving monochromators or analyzing crystals. R.W.H.

N65-30063# Los Alamos Scientific Lab., N. Mex.
OPTIMIZING ZOOM SYSTEMS WITH THE LASL LENS DESIGN PROGRAM
Charles A. Lehman [1965] 11 p
(Contract W-7405-ENG-36)
(LA-DC-6856; CONF-650424-1)

This paper discusses the techniques used in the design of optical systems requiring simultaneous optimization under several conditions of use. Zoom (varifocal) lenses are included in the category of systems susceptible to these techniques. The paper includes performance data on a real zoom system designed with the aid of this program. Author

N65-30114# Delaware Univ., Newark. Dept. of Physics.
SCANNING OF LIGHT BEAMS USING FRANZ-KELDYSH-EFFECT
K. W. Boer [1965] 7 p refs Sponsored by Army
(AROD-4461-3; AD-616542)

The possible use of the Franz-Keldysh effect of developing a two dimensional scanning and display system is discussed analytically. A light beam can be deflected several degrees using the shift of the absorption edge due to the Franz-Keldysh effect in an inhomogeneous electric field, causing the index of refraction to be inhomogeneous. A differential equation describing the path of a light ray through crystalline material serves as the basis for investigation of resolution, refocusing, absorption, and angle of deflection, as related to crystal thickness. Transl. by J.M.D.

N65-30173# Vanderbilt Univ., Nashville, Tenn.
THE ABSORPTION OF SOUND IN METHANE-d_3
Thomas Riddell Mullins (M.A. Thesis) Aug. 1964 32 p refs Sponsored by AEC
(TID-21414)

The tube method was used to study the ultrasonic absorption properties of methane-d_3. The f/p range was covered by varying the pressure and at each pressure the speaker was moved down the tube, and the decrease in amplitude was plotted against the distance. The relaxation absorption was obtained by subtracting the effects of classical and tube absorption, and was plotted against the logarithm of the corresponding f/p value. The value of μ_{max} chosen was 0.133 nepers per wavelength, which was in close agreement with the theoretical prediction of 0.132 nepers per wavelength. The experimental value of f_m^1 was 78 kilocycles per atm, which corresponded to a relaxation time of 2.39 microseconds. Also, it was noted that the effect of deuteration of methane on intermolecular energy transfer decreased the collision efficiency with the exception of an interchange of CH_3D and CH_2D_2. Proceeding on the assumption that impurities are not a factor, the possibility of a change in the interaction potential of the molecules in CH_3D was suggested based on the results of recent viscosity measurements. R.W.H.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-29165# Instituto Superiore di Sanita, Rome (Italy).
THE (E'E,P) EXPERIMENT: RESULTS OBTAINED AND PLANNED PROPOSALS [L'ESPERIENZA (E,E'P): RISULTATI OTTENUTI E SVILUPPI FUTURI]
G. Campos Venuti and P. Salvadori 22 Jan. 1965 44 p refs Presented at the Natl. Labs of Frascati Conf., 22 Jan. 1965
(ISS-65/3)

After having briefly summarized the reasons for an (e'e,p) experiment, the apparatus which was used to study the binding energies of protons in 1s and 1p shells of C^{12}, and in 1s, 1p and 2s 1d in Al^{27} and S^{32}, is extensively discussed. Experimental curves for these nuclei versus the energy of the incident electrons are then reported together with their graphical decompositions into components corresponding to the different levels. A new device to measure the binding energies and the angular distributions of the protons produced in the (e,e'p) reaction is shown. Finally, requests for the use of the synchrotron are presented in order to study a certain number of nuclei in a year's time. Author

N65-29179 European Organization for Nuclear Research, Geneva (Switzerland).
EXPERIMENTAL STUDY OF THE PRODUCTION OF PARTICLES AT SMALL ANGLE IN PROTON-PROTON AND PROTON-NUCLEUS COLLISIONS AT 20 GeV [ETUDE EXPERIMENTALE DE LA PRODUCTION DE PARTICULES A PETIT ANGLE DANS LES COLLISIONS PROTON-PROTON ET PROTON-NOYAU A 20 GeV]
B. Jordan 7 Apr. 1965 114 p refs In FRENCH
(CERN-65-14)

Various theoretical models are used in attempt to explain experimental data on small-angle production of particles. More than 300 cross sections were measured, giving spectra between 4 and 12 GeV/c for positive and negative pi and kappa mesons in proton-proton, proton-beryllium, and proton-lead collisions at incident impulsions of 18.1 and 23.1 GeV/c. The Fermi statistical model, and the hydrodynamic, fireball, peripheral, multiperipheral, and isobar models are investigated. It was found that the statistical model satisfactorily represents the phenomenon of pionization, and that isobars play an important part in the production of positive pions. Formation of the center of pionization and the excitation of isobars are not entirely distinct, and in fact are correlated. It is possible that the energy of the pionization center depends on the nature and the angle of exit of the excited isobars. Trans by J.M.D.

N65-29207# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
ABSOLUTE POLARIZATION MEASUREMENTS IN PROTON SCATTERING IN THE 140 MeV ENERGY RANGE
O. N. Jarvis, B. Rose, and J. P. Scanlon Apr. 1965 39 p refs
(AERE-R-4896) HMSO: 5s 6d

The polarization of the proton beam extracted from the 110" Synchrocyclotron has been determined to an accuracy of ±1% using two independent techniques. Measurements with this beam have shown that the absolute calibration of all the published proton-nucleus polarization data in the energy range between 50 and 150 MeV are considerably in error. This fact means that the proton-proton polarization data are also in error. The appropriate correction factors to be applied to the published experimental results are listed. Author

N65-29213# Oak Ridge National Lab., Tenn.
SPACETIME AND ELEMENTARY PARTICLE GROUPS
M. A. Melvin (Florida State Univ.) and R. Roskies Jul. 1965 18 p refs Presented at Conf. on Resonant Particles, Ohio Univ., Athens, Jun. 10–12, 1965
(Contract W-7405-ENG-26)
(ORNL-3838) CFSTI: $1.00

In this paper we discuss the possbilities of deriving mass-splitting formulas from a conjectured coupling of the space-time symmetry associated with isolated particles, with their approximate internal symmetry. We use the theory of the hydrogenic spectrum to illustrate the extent to which one might expect to find mass formulas by guessing a group of higher symmetry in which manifest symmetries are embedded. We then discuss the serious problems which arise if we assume that mass splitting may be interpreted in terms of the existence of a supersymmetry group G within which spacetime and internal symmetries are coupled nontrivially, i.e., if we assume that G does not contain the mass-determining spacetime group as a direct product factor. We conclude that, barring a possible radical redefinition of mass, the explanation of mass splitting is not to be found by embedding the Poincaré group into a finite-parameter Lie group G. Author

N65-29220# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).
IONIZATION OF CESIUM ON POROUS TUNGSTEN [IONISATION VON CASIUM AUF POROSEM WOLFRAM]
G. F. Au 21 Dec. 1964 159 p refs In GERMAN; ENGLISH summary
(DLR-T-B-64-47) Available from Zentralstelle für Luftfahrtdokumentation und Inform. (ZLDI), Munich: DM 16

This paper deals with the essential physical details of the cesium vapor transport through porous tungsten and the process of ionization. The transport of cesium vapor is treated using the theory of free molecular flow, surface diffusion and capillary condensation. Experimental methods for the determination of ion current density, ionization efficiency, neutral fraction, emitter temperature and ion microscopic investigation give good knowledge about the present status of contact ion sources. The results obtained so far about adsorption phenomens indicate that quantum mechanical treatment is necessary for a complete understanding of the contact ionization. Author

N65-29267# Israel Inst. of Tech., Haifa. Dept. of Physics.
CAUSALITY IN S-MATRIX THEORY
A. Peres 8 Mar. 1965 51 p refs
(Grant AF-EOAR-64-20)
(SR-15; AD-466508)

The purpose of this paper is to discuss a few common sense requirements which any decent S-matrix must satisfy. First, we require that if the initial state consists of wave packets colliding at time t', and the final state of wave packets colliding (when produced backwards) at time t", then the transition amplitude should be vanishingly small if $t'' < t'$. Moreover, if there is an appreciable time delay ($t'' > t'$), the latter should be interpretable as arising from the propagation of an unstable intermediate particle. The above requirements, which are readily generalized to multiple scattering processes, are sufficient to derive the pole structure of the S-matrix and the existence of antiparticles. However, maximal analyticity and crossing symmetry cannot be proved from these assumptions—they can only be postulated separately. Author

N65-29280# California Univ., Livermore. Lawrence Radiation Lab.
SCATTERING PHASE SHIFT EQUATIONS AND RESONANCE EQUATIONS
L. David Roper 21 May 1965 40 p refs
(Contract W-7405-ENG-48)
(UCRL-14193)

This report contains equations that relate the phase shifts and partial-wave amplitudes for elastic scattering. The effect of inelasticity on elastic scattering is included. Also, resonance equations are given, and many curves show the behavior of a resonance as a function of the various resonance parameters for the case of π-p scattering. In particular, the unusual behavior of highly absorptive resonances is emphasized. Author

N65-29343 Joint Publications Research Service, Washington, D. C.
STRONG FIELD INTERACTIONS AND NONLINEAR EFFECTS FROM STIMULATED OPTICAL EMISSIONS
Wei-Han T'an *In its* Transl. on Communist China's Sci. and Technol., No. 196 12 Jul. 1965 p 1–14 refs (See N65-29342 18-34) CFSTI: $3.00

Energy level split and shift problems under strong field actions are discussed. In the analysis of strong field action, the appearance of radiation pressure when electrons interact with the radiation field causing shifts in energy levels is considered. Two kinds of nonlinear effects from stimulated optical emission are described. The electromagnetic theory of nonlinear media and problems concerning nonlinear materials are presented. N.E.A.

N65-29344 Joint Publications Research Service, Washington, D. C.
ANOMALOUS MAGNETIC MOMENT OF ELEMENTARY PARTICLES DUE TO ELECTROMAGNETIC MASS DIFFERENCE
Hu Ning and Kuo-Chen Yang *In its* Transl. on Communist China's Sci. and Technol., No. 196 12 Jul. 1965 p 15–18 refs (See N65-29342 18-34) CFSTI: $3.00

Values of the anomalous magnetic moment μ for baryons, from the eight-fold SU(3) theory, and the cutoff parameter K determined from the nuclear electromagnetic mass difference are substituted in equations normally used for obtaining baryon mass, for calculating the electromagnetic masses. Theoretically computed values of the electromagnetic mass difference are in agreement with experimental values and the comparisons are tabulated. The correctness of theoretical values for μ for the different hyperons was verified, and the comparison affords an explanation of the electromagnetic mass difference for the various baryons. Similar considerations are used to explain the electromagnetic mass for pi mesons and K mesons, and results for calculations for these particles are also tabulated. Experiments show that the mass of π^0 is smaller than that of π^+, but that K^0 has a greater mass than K^+. Other comparisons from the tabulated data are made, and in general the agreement between experiment and theory appears to give strong support to the SU(3) theory. L.S.

N65-29382*# Yale Univ., New Haven, Conn. Gibbs Lab.
ATOMIC BEAM SOURCE OF POLARIZED ELECTRONS
V. W. Hughes, R. L. Long, Jr., and W. Raith [1959] 5 p
(Grant NsG-1-59)
(NASA-CR-51186) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Methods of obtaining polarized electrons by photoelectric emission from a ferromagnet, by field emission from a ferromagnet, by optical pumping techniques, and by atomic beam techniques are discussed. An apparatus was constructed that produces polarized electrons by an atomic beam method in which polarized alkali atoms are selected by deflection in an inhomogeneous magnetic field, the atoms in turn being photoionized to give polarized electrons. The design characteristics of the polarized electron source with potassium atoms are listed. Energy levels of the hyperfine structure intervals of the ground state of the alkali atoms and their isotopes in a magnetic field are tabulated. L.S.

N65-29393*# Columbia Univ., New York. Radiation Lab.
MAGNETIC SHIELDING FOR THE BENDIX RESISTANCE STRIP MULTIPLIER
P. Feldman, R. Novick, and G. Sprott [1963] 6 p refs Submitted for Publication
(Grant NsG-360)
(NASA-CR-59193) CFSTI: HC $1.00/MF $0.50 CSCL 18D

To prevent interaction of the magnetic field in the multiplier with other magnetic fields in the apparatus, the multiplier was modified. A magnetic circuit was designed which permits proper operation within an iron shield. The original grid and cathode were removed, and the atomic beam is allowed to pass between the dynode and field strips near the input end of the multiplier. Most of the metastable atoms that reach the detector decay with the emission of an electron and a positive ion, and the electrons which are accelerated to the dynode strip by a transverse electric field initiate the multiplication process. The shield is a soft iron box with 1/4-in. walls. A drawing, including dimensions, of the multiplier is included. C.T.C.

N65-29398*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
CALCULATED ELASTIC SCATTERING CROSS SECTIONS FOR THE Li^+-He SYSTEM
G. G. Weber and R. B. Bernstein 6 Oct. 1964 27 p refs
(Grant NsG-275-62; Contract AT(11-1)-1328)
(NASA-CR-59172; WIS-TCI-67; COO-1328-12) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Calculations of the energy dependence of the total and differential elastic scattering cross sections for the Li^+-He system have been carried out for a number of assumed interaction potentials (from the literature). All of these are known to yield good fits to existing mobility data, sensitive primarily to the long-range r^{-4} term in the potential. The present results show that the total quantum cross sections as well as the angular distributions are quite sensitive to the potential also at short range (e.g. $r < 4$Å), even at low collision energies ($E < 1$eV). In particular, the behavior of the extrema in the total cross sections offers a means of discrimination among the potentials. Author

N65-29402*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASUREMENT OF THE CESIUM-CESIUM TOTAL CROSS SECTION BY ATOMIC BEAM TECHNIQUES
Eugene J. Manista and John W. Sheldon [1964] 6 p refs Submitted for Publication
(NASA-TM-X-54767) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The cesium-cesium total cross section was measured using atomic beam methods and the initial results are presented. The average value of the cross section measured for five runs is 2040 Å^2. This is consistent with a previously obtained value if allowance is made for the angular resolution of the two experiments. The average relative velocity during the runs is 3.5×10^4 cm per sec. The estimated error in the absolute magnitude of the equivalent hard sphere cross section is 20% which is due to problems associated with the proper

determination of the density of the cesium vapor in the scattering chamber. R.N.A.

N65-29407*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
NUMERICAL EVALUATION OF QUANTUM EFFECTS ON TRANSPORT CROSS SECTIONS
S. Imam-Rahajoe, C. F. Curtiss, and R. B. Bernstein 1 Aug. 1964 32 p refs
(Grant NsG-275-62; Contract AT(11-1)-1328)
(NASA-CR-58804; WIS-TCI-59)

Quantum mechanical calculations of the transport cross sections $Q^{(1)*}$ and $Q^{(2)*}$ and the associated $\Omega^{(m,t)*}$ integrals are presented for a Lennard-Jones (12,6) potential. The computations are made for three values of the quantum parameter Δ^* (=1,2,3), and include the effects of statistics. The quantum effects become quite important at reduced temperatures T^* below about unity. The quantum corrections to the integrals are negative at moderate temperatures, but become positive at higher temperatures. Author

N65-29409*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GEOMETRICAL ORIGIN OF INTERNAL SYMMETRIES
Jonas Stasys Zmuidzinas [1964] 8 p refs Submitted for Publication
(Contract NAS7-100)
(NASA-CR-64079) CFSTI: HC $1.00/MF $0.50 CSCL 20H

In this note, a group-theoretical method of obtaining internal symmetries of elementary particles from the geometry of space time is outlined. The basis of the theory is the group T having as the generators of its Lie algebra τ the identity, momentum, and position operators I, P_μ, and X_μ, $\mu = 0, 1, 2, 3$, satisfying

$$[P_\mu, X_\nu] = ig_{\mu\nu} I, \ (n = c = 1),$$

$$[P_\mu, P_\nu] = [X_\mu, X_\nu] = [P_\mu, I] = [X_\mu, I] = 0,$$

$$(g_{\mu\nu}) = \text{diag}\ (1, -1, -1, -1).$$

These equations represent the simplest covariant generalization of the nonrelativistic canonical communication relations $[p_i, q_j] = -i\delta_{ij}$. Irreducible unitary representations of T are labeled by the eigenvalue σ of I; for the maximal abelian subalgebra of τ the four P_μ is chosen. The basic states are thus $|\sigma p\rangle$, to be physically interpreted as the momentum eigenstates of matter in which all spin, isospin, dependence is washed out or ignored. The aim is to show how these additional quantum numbers can be regenerated by starting with the basic states only. N.E.A.

N65-29426*# Texas Univ., Austin. Dept. of Physics.
FINITE-MASS HELIUM ATOMS. II: THE 2^3P STATE +
Milos Machacek, Frank Sanders, and Charles W. Scherr [1964] 10 p refs
(Grant NsG-263-62)
(NASA-CR-59044) CFSTI: HC $1.00/MF $0.50 CSCL 07D

The 2^3P states of the helium isoelectronic series are investigated via 50-term variational wavefunctions containing two nonlinear parameters. The Hamiltonian, spin free and nonrelativistic, is written directly in center-of-mass coordinates so that no adiabatic approximation is required. The expectation values of the Hamiltonian and of moments of the interparticle separations are reported. Isotope shifts are found, and, as noted in a preliminary report, are in excellent agreement with experiment. In order to compare the results with previous theoretical results the systems were similarly studied in the infinite nuclear mass limit (adiabatic approximation). The energies so obtained are the deepest so far obtained by a direct calculation with a variational wavefunction. The expectation values of the operators were subjected to a differencing process to obtain estimates of the perturbation expansion coefficients for them, and the results are in good agreement with the directly calculated results of Knight and Scherr. Author

N65-29441*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Space Sciences Div.
ANALYSES OF THE NMR SPECTRA OF THE VINYL PROTONS OF CYCLOPENTADIENE AND CYCLOHEXADIENE USING SPIN DECOUPLING
Stanley L. Manatt and Daniel D. Elleman [1964] 18 p refs Submitted for Publication
(Contract NAS7-100)
(NASA-CR-64078) CFSTI: HC $1.00/MF $0.50 CSCL 07D

An analysis of the vinyl proton spectrum of cyclopentadiene (I) which has instead of a heteroatom an insulating methylene group between the 1- and 4-position of the cis-diene is reported. The analysis was accomplished using double and triple irradiation techniques. To the best knowledge, there is no previous report of the n.m.r. parameters for a six membered ring *cis*-1,3-diene. Using proton-proton decoupling, the vinyl proton region of cyclohexadiene (II) was simplified to an analyzable A_2B_2 spectrum. The molecule II may approximate a model for *cis*-1,3-butadiene and as such its n.m.r. coupling constants could indicate something about the electronic structure of *cis*-dienes. The n.m.r. parameters for I and II are discussed in terms of the mechanisms of long-range proton-proton couplings, effects of ring size, and the relative signs of the various spin-spin couplings. N.E.A.

N65-29453*# Maryland Univ., College Park. Institute for Molecular Physics.
AUTOMATIC CALCULATION OF THE TRANSPORT COLLISION INTEGRALS WITH TABLES FOR THE MORSE POTENTIAL
Francis J. Smith and R. J. Munn 12 Aug. 1964 29 p refs
(Grant NsG-5)
(NASA-CR-58446; IMP-NASA-39) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A computer programme is described for calculating the classical and quantal JWKB Chapman-Enskog collision integrals $\Omega^{(l,s)}$ (T) for any reasonable interaction potential. With the programme it was possible in about 10 or 15 minutes on a fast computer to calculate more than 500 collision integrals covering a complete range of valaues of *l*, s, and T to an accuracy of better than 1 part in 1,000. This was made possible by the use of efficient numerical techniques such as weighted Gaussian quadratures and by the general optimization of all numerical and logical processes. The programme was checked against previous tables for the Lennard-Jones and Stockmayer potentials. It was also used to list values of the collision integrals and Kihara's corrections to the coefficients of viscosity, thermal conductivity, diffusion and thermal diffusion for the Morse potential. Author

N65-29500 European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Div.
PROCEEDINGS OF THE Vth INTERNATIONAL CONFERENCE ON NUCLEAR PHOTOGRAPHY, VOLUME 1
W. O. Lock ed. Jan. 1965 108 p refs Conf. held at CERN, Geneva, 15–18 Sep. 1964
(CERN-65-4, Vol. 1)

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7. SOME ASPECTS OF APPLICATIONS OF PHOTOGRAPHIC EMULSIONS K. D. Tolstov (Joint Inst. for Nuclear Res.) 13 p refs (See N65-29507 18-24)

8. THE FUTURE PERSPECTIVES FOR EMULSION WORK AT CERN B. P. Gregory 11 p (See N65-29508 18-24)

N65-29503 NIKFI Inst., Moscow (USSR).

NEW PHOTOGRAPHIC MATERIALS FOR NUCLEAR RESEARCH [NOUVEAUX MATERIAUX PHOTOGRAPHIQUES POUR LES RECHERCHES NUCLEAIRES]

C. S. Bogomolov *In* CERN Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. 1 Jan. 1965 12 p refs In FRENCH (See N65-29500 18-24)

Various methods of preparing nuclear emulsions for photographic study of subatomic particles are surveyed. These procedures, developed on a commercial scale in various countries during the years 1962 and 1963, are discussed with respect to chemical stability and photographic sensitivity.

Transl. J.M.D.

N65-29504 Centre de Recherches Nucleaires, Strasbourg (France). Departement de Physique Corpusculaire.

SOME PROPERTIES OF NUCLEAR EMULSIONS [QUELQUES PROPRIETES DES EMULSIONS NUCLEAIRES]

P. Cuer *In* CERN Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. I Jan. 1965 24 p refs In FRENCH (See N65-29500 18-24)

The subject of nuclear emulsions is reviewed generally. Topics discussed are optical and mechanical properties of nuclear emulsions, corpuscular photography, threshold of sensitivity, topography of latent images, spontaneous evolution of the image, ionographic emulsions, and fine measurements with electronic microscopes. Transl. by J.M.D.

N65-29505 California Univ., Berkeley. Lawrence Radiation Lab.

DATA HANDLING IN EMULSION EXPERIMENTS

Walter H. Barkas *In* CERN Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. I Jan. 1965 11 p refs (See N65-29500 18-24)

A discussion of methods to facilitate emulsion data handling by those with modest equipment, and those possessing the resources of a large laboratory is presented. Cited are methods and instrumentation used in data reduction and recording. Included is a review of experiments on the new decay mode, $K_{\mu 4}^{\circ}$; neutron spectroscopy as applied using emulsion detection; studies of the stopping power difference of matter for particles of opposite electric charge; and research on the decay of the π° meson. S.C.W.

N65-29506 Naval Research Lab., Washington, D. C.

MEASUREMENTS IN NUCLEAR EMULSIONS

A. J. Herz *In* CERN Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. I Jan. 1965 7 p refs (See N65-29500 18-24)

Presented is a brief synopsis on the development of nuclear research emulsions and remarks on papers presented in the following areas: the range-energy relation, the rate of energy loss in the extreme relativistic region, temperature equilibrium, spurious scattering, and the value of the scattering constant. S.C.W.

N65-29507 Joint Inst. for Nuclear Research, Dubna (USSR).

SOME ASPECTS OF APPLICATIONS OF PHOTOGRAPHIC EMULSIONS

K. D. Tolstov *In* CERN Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. 1 Jan. 1965 13 p refs (See N65-29500 18-24)

Presented are data in the following areas of research: (1) the enrichment of emulsions with hydrogen; (2) the use of emulsion stacks with hydrogen targets; and (3) inherent problems associated with the application of photographic emulsions, and the combination of nuclear emulsions with other techniques. S.C.W.

N65-29508 European Organization for Nuclear Research, Geneva (Switzerland).

THE FUTURE PERSPECTIVES FOR EMULSION WORK AT CERN

B. P. Gregory *In its* Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. 1 Jan. 1965 10 p (See N65-29500 18-24)

Presented is the concluding address of the Conference which focused on the future of the emulsion technique in high-energy physics and at CERN. Emphasized are successful experiments of recent years and their future significance. Discussed are: the use of emulsions for studies of small angle proton-proton scattering; hyperfragment research; magnetic moment studies; and studies designed to solve the problem of scanning in emulsions. S.C.W.

N65-29575# Geophysics Corp. of America, Bedford, Mass.

THEORETICAL STUDIES OF HEAVY ION EXCHANGE IN AIR Final Report, 17 Jun. 1963–30 Jun. 1964

A. Dalgarno, T. C. Degges, E. T. Florance, G. A. Victor, and T. G. Webb Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1965 192 p refs

(Contract AF 29(601)-6108)

(GCA-TR-64-9-A; WL-TR-64-110; AD-616103)

The results are presented of a search for charge exchange reactions possessing small energy defects (for which the Massey adiabatic theory predicts a large cross section) between typical metallic ions and neutral atomic and molecular atmospheric constituents. The Brinkman-Kramers (BK) approximation has been applied to calculate the differential and total cross sections (for velocities between 0.1 and 75 au) of the reaction

$$Al^{+}(3s^{2}\,{}^{1}S) + A(3p^{6}\,{}^{1}S) \rightarrow Al(3p^{2}\,P) + A^{+}(3p^{5}\,{}^{2}P).$$

These are compared with available experimental data. It is estimated that the cross sections for radiative charge exchange processes are negligible by comparison with those for the radiationless processes except at the lowest velocities of interest. The electron affinity of the projectile ion was found to be an effective parameter in determining certain charge exchange cross sections. The possibility was investigated of using resonance charge

exchange models or high energy classical models to calculate cross sections for nonresonant reactions, but no satisfactory model has yet emerged. Author

N65-29602# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
STUDY OF THE BEHAVIOR OF ARTIFICIAL RADIOACTIVE AEROSOLS. APPLICATIONS TO SOME PROBLEMS OF ATMOSPHERIC CIRCULATION
Gerard Lambert (Ph.D. Thesis—Paris Univ.) May 1965 318 p refs Transl. into ENGLISH of Rept. CEA-R-2347, "Etude du Comportement des Aerosols Radioactifs Artificials. Applications a Quelques Problems de Circulation Atmospherique" 1963 227 p
(AEC-TR-6548; CEA-R-2347)

The conditions under which the artificial radioactive wastes, particularly the aerosols, may be used as atmospheric tracers and the progress which may be expected in their employment were studied. Also, the different types of radioactive aerosols of all origins present in the atmosphere and their respective concentrations were considered. The techniques employed for measuring beta activity of the aerosols, the difficulties encountered in these measurements, the accuracy which may be expected, and the systematic measurements which were made are described. The problem of the measurement of aerosols in the upper atmosphere up to an altitude of about 30 km; the objectives of these measurements; and the techniques employed are included. Further, the deposition on the surface of the earth of artificial radioactive wastes is discussed. The distribution of this deposit as a function of time for different regions of the globe is given and these data are correlated with the other problems discussed in this thesis. E.E.B.

N65-29608# Los Alamos Scientific Lab., N. Mex.
ON THE PROPER USE OF TRANSFORMATIONS OF LOG NORMAL FUNCTIONS IN SMALL PARTICLE STATISTICS
A. Goldman, H. D. Lewis, and R. H. Moore Dec. 1964 34 p refs
(Contract W-7405-ENG-36)
(LA-3262) CFSTI: $2.00

A standard notation is suggested for use in all fields concerned with small particle data analysis. The representation of particle size data by various forms of the log normal function is discussed and related to methods of "particle size" measurement. Transformations among parameters defining the functions are discussed, and the general functional relationships are developed and listed in tabular form. The use of the proper parameters for data comparisons or for distribution definition is emphasized. Author

N65-29657*# Oak Ridge National Lab., Tenn.
NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL NUCLEON-MESON CASCADE EQUATIONS
R. G. Alsmiller, J. E. Murphy, and J. Barish [1964] 14 p refs Sponsored in Part by AEC
(NASA Order R-104)
(NASA-CR-58736) CFSTI: HC $1.00/MF $0.50 CSCL 20H

In shielding calculations for high-energy accelerators it is necessary to solve the nucleon–meson cascade equations numerically for very large distances. For the case of a 10-GeV proton beam and a set of quite special physical assumptions, an analytic solution has been obtained and compared with the numerical solution. The two solutions are shown to be in excellent agreement for thicknesses as large as 30 collision mean free paths ($\sim 2800 g/cm^2$). Author

N65-29665# Los Alamos Scientific Lab., N. Mex.
INTEGRAL GAMMA AND NEUTRON MEASUREMENTS ON THE KIWI B4D-202 AND KIWI B4E-301 REACTORS
F. C. V. Worman and P. K. Lee 23 Jul. 1965 102 p refs
(Contract W-7405-ENG-36)
(LA-3286) CFSTI: $4.00

The leakage radiations produced by the Kiwi B4D-202 and Kiwi B4E-301 reactors were evaluated, and integral measurements were made of gamma dose, neutron flux, and neutron dose. Gamma doses in air for Kiwi B3D ranged from 1.2×10^5 rads at 60 feet to less than 20 rads at 1800 feet. Neutron doses in air varied from 6.43×10^4 rads at 60 feet to 2.64 rads at 3000 feet. Thermal neutron fluxes declined from 87.2% of the total neutron flux at 60 feet to 24.6% at 1500 feet. For Kiwi B4E the gamma doses in air were from 5.93×10^5 rads at 60 feet to 1.93×10^2 rads at 1800 feet. Neutron doses in air varied from 2.21×10^5 rads at 60 feet to 3.24 rads at 3000 feet. Thermal neutron fluxes diminished from 123% of the total fast neutron flux at 60 feet to 28.8% at 1500 ft. E.E.B.

N65-29674# California Univ., La Jolla.
EXCHANGE AND CORRELATION EFFECTS IN AN INHOMOGENEOUS ELECTRON GAS
W. Kohn and L. J. Shau 12 May 1965 7 p refs
(Contract Nonr-2216(11))
(TR-30; AD-615799)

From a theory of Hohenberg and Kohn, approximation methods for treating an inhomogeneous system of interacting electrons are developed. They lead to self-consistent equations analogous to the Hartree and Hartree-Fock equations, respectively. In these equations the exchange and correlation portions of the chemical potential of a uniform electron gas appear as corrections to the electrostatic potential. Author

N65-29689# Los Alamos Scientific Lab., N. Mex.
BIBLIOGRAPHY OF CROSS SECTION AND SCATTERING DATA FOR THE REACTIONS D + D AND T + D
R. V. Winsor 7 Jul. 1965 16 p refs
(Contract W-7405-ENG-36)
(LA-3322-MS) CFSTI: $1.00

N65-29701# Israel Inst. of Tech., Haifa. Dept. of Physics.
REMOVAL OF INFRARED DIVERGENCES Scientific Report No. 13
Asher Peres 7 Oct. 1964 4 p refs
(Grant AF-EOAR-64-20)
(ARL-65-153; AD-466506)

Infrared divergences are removed by putting external particles out of their mass shells. Scattering cross sections then depend on the observation distance, rather than the energy resolution. Author

N65-29702# Israel Inst. of Tech., Haifa. Dept. of Physics.
ON SCHWINGER'S PARAMETRIZATION OF FEYNMAN GRAPHS
Asher Peres 16 Oct. 1964 25 p refs
(Grant AF-EOAR-64-20)
(ARL-65-155; AD-466507)

Results obtained from Schwinger's parametrization of integrals obtained from perturbative expansions of the S-matrix by means of Feynman diagrams are given. It is shown that all the integrations over the internal moments can be performed explicitly. The formulas can be easily modified to switch off adiabatically the interaction outside a given space–time domain. Possible applications of this method to the investigation of analytic properties of Feynman graphs are also given. C.T.C.

N65-29706# Naval Radiological Defense Lab., San Francisco, Calif.

CALCULATED EFFICIENCIES OF LITHIUM-DRIFTED GERMANIUM DETECTORS

H. P. Hotz (Marietta Coll., Ohio) J. M. Mathiesen, and J. P. Hurley 3 Feb. 1965 30 p refs

(USNRDL-TR-817; AD-460599)

Gamma-ray detection efficiencies for Ge(Li) detectors were calculated on an IBM 704 computer for crystals of 1.0 × 2.0 cm and 2.0 × 3.0 cm cross section. Depletion depths from 1.0 to 10.0 mm and source to crystal distances from 1.0 to 25.0 cm were selected. Author

N65-29712# European Atomic Energy Community, Brussels (Belgium).

PRELIMINARY RESULTS ON TIMING WITH PHOTOMULTIPLIERS AND SOLID STATE DETECTORS

G. Bertolini, V. Mandl, A. Pedrini, and L. Stanchi 1965 59 p refs

(EUR-2274.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 70 Belg. Fr.

Electronic instruments for a delayed coincidence spectrometer in nanosecond region have been developed and a half-life measurement of the 73.6 KeV excited level of Np^{239} has been performed. Preliminary measurements of the time resolution with photomultipliers have been done. Author

N65-29856# European Atomic Energy Community, Brussels (Belgium).

MATERIAL BALANCES IN NUCLEAR ENERGY

G. Ritter and G. Blässer 1965 21 p

(EUR-2412 e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The authors are of the opinion that one should not only judge the potential of reactor types by their constructional features and peculiarities or by the comparison of the electricity generating costs at the present situation but that a long term nuclear program should also be based on a thorough study of the complete material balances for the different types of systems. From the point of view of fuel conservation, fast breeders and advanced thermal thorium converters will be shown to be preferable by orders of magnitude to the more conventional light water, heavy water and graphite-gas reactors. Author

N65-29867# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.

EXCITED-STATE WAVE FUNCTIONS

P. S. Kelly, J. Sokoloff, and B. H. Armstrong Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1965 179 p refs

(Contract AF 29(601)-6199)

(WL-TR-64-172; AD-615976)

Analytic self-consistent field functions have been determined for the 20 L-S coupled terms of the configurations $1s^2 2s^2 2p^k 3s$, and for the 56 terms of the configurations $1s^2 2s^2 2p^k 3d$ where k = 0, 1, 2, 3. These functions have been employed in the computation of oscillator strengths. A total of 156 allowed dipole transitions of the types 2s – 2p, 2p – 3s, and 2p – 3d have been computed. Radial equations for open-shell atoms in the unrestricted H-F approximation have been derived in general form. A program has been completed for the calculation of the continuum of the ground-state H-F operator in the application of the Goldstone many-body formalism to the calculation of correlation energies of finite atoms. NIV oscillator strengths of the transitions $2s^2\ {}^1S \rightarrow 2snp\ {}^1P$, where n runs from 2 to 8, have been calculated in the random-phase approximation (RPA). It was found that the RPA alters only the resonance oscillator strength, lowering it by about 30 percent. An analysis of the Coulomb approximation (CA) of Bates and Damgaard is presented, by comparison of CA wave functions with H-F wave functions, and by a derivation of an approximate one-electron equation which indicates the choice of experimental energy parameter. A discussion of the normalization of CA wave functions is given along with a discussion of the relevance of effective range theory to the CA, and the calculation of some effective ranges in oxygen. Extended tables of CA radial dipole integrals are presented. Author

N65-29947# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.

PROOF BY LOWER BOUND METHODS THAT NO SINGLY-EXCITED BOUND STATES EXIST IN H^-

William H. Miller 14 May 1965 5 p refs

(Contract Nonr-1866)

(AD-464260)

A previously presented lower bound method has been extended to make it possible to obtain lower bounds above the beginning of the one-electron continuum in a two-electron atom. The nature of this extension is briefly predicted and the method is applied to the eigenvalues of the hydrogen negative ion, H^-. It is found that the lowest bound ^3S state must lie above −0.4871 a.u. —and since there can be no bound states of this symmetry above −0.50 a.u. there are no bound ^3S states in H^-. Also the lowest ^3P_u (1s2p) state and the first excited ^1S (1s2s) state have lower bounds above −0.50 a.u. The one-electron continuum for ^3P_g states begins at −0.125 a.u. in H^-. The best lower bound obtained for the lowest state of this symmetry ($2p^2$) is −0.1260. Thus we cannot conclude that $2p^2\ {}^3P$ is not bound. Author

N65-29958*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

AUTOIONIZATION STATES OF H^- BELOW THE n = 2 LEVEL OF H

A. Temkin and J. F. Walker (New York Univ.) 7 May 1965 23 p refs

(NASA-TM-X-55274; X-640-65-197) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The resonances below the inelastic (n = 2) threshold of electron-hydrogen scattering are examined by the projection operator technique of Feshbach. This technique converts the problem to an eigenvalue problem for a projected Hamiltonian in which the auto-ionization levels of H^- become true bound states. The number of levels of this problem is found to be infinite and cluster at the n = 2 level of H. The relative spacings of the levels are identical to the resonances in e-H scattering as derived by Gailitis and Damburg. Author

N65-29976# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE A.A.E.C. NUCLEAR DATA CARD LIBRARY

G. Doherty [1965] 11 p refs

(AAEC-E-119)

This report describes the compilation of the A.A.E.C. nuclear data card library and the conventions relating to the use of the data in neutronics calculations. Details of data processing programmes, library formats, and the extent of the information available for each nuclide are given in the appendices. Author

N65-29978# California Univ., Livermore. Lawrence Radiation Lab.

DEPENDENCE OF THE SOLUTIONS OF THE SCHRODINGER EQUATION ON THE DIELECTRIC CONSTANT IN THE COMPLETE SCREENED COULOMB POTENTIAL

Carl A. Rouse 15 Apr. 1965 8 p refs
(Contract W-7405-ENG-48)
(UCRL-12461)

Some numerical solutions of the radial Schrödinger equation with the complete screened Coulomb potential were considered in two approximations for the effects of neutral atoms. Potential $V^A(r)$ treats the neutrals as a continuum with dielectric constant n_0 everywhere. Potential $V^B(r)$ also treats the neutrals as a continuum but outside the mean excluded volume of radius a. It is shown that for the same charge in n_0 greater than 1.0, $V^B(r)$ produces a greater change in the quantum number than $V^A(r)$. $V^A(r)$ produces a significant change in the position of the maximum charge probability density whereas $V^B(r)$ does not. R.N.A.

N65-29980# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
DIFFERENTIAL NEUTRON SCATTERING FROM HYDROGENEOUS MODERATORS
J. R. Beyster, J. C. Young, J. M. Neill, and W. R. Mowry 6 Mar. 1965 14 p refs Presented at the IAEA Symp. on Pulsed Neutron Res., Karlsruhe, W. Germany, May 1965
(Contract AT(04-3)-167)
(GA-6295; SM-62/64)

Measurements are reported for differential neutron scattering from hydrogeneous moderators. A diagram of the experimental arrangement is shown, and scattering cross section diagrams for H_2O, D_2O, and zirconium hydride, along with plots of $\bar{\mu}$ (a function from which the energy dependent transport cross section can be determined) vs the neutron energy for H_2O and for D_2O. L.S.

N65-30021# California Univ., Riverside.
REGGE TRAJECTORIES VS. VANISHING RENORMALIZATION CONSTANTS AS DYNAMICAL CRITERIA
P. E. Kaus and F. Zachariasen (Calif. Inst. of Tech.) Jan. 1965 13 p refs
(Contracts AT(11-1)-68; AT(11-1)-34)
(UCR-34P107-8; CALT-68-25)

The connection between Reggeness and the vanishing of renormalization constants is explored. It is found that if a field theory, $Z_1 \to 0$, and $Z_3 \to 0_1$ such that $Z_1/Z_3 \to 0$, then a Regge trajectory moves smoothly under an elementary particle pole so that the particle becomes dynamical in the Regge sense. Thus a bootstrapped world may perhaps equally well be defined as being a field theory with all renormalization constants set equal to zero, as by saying all particles lie on Regge trajectories. Author

N65-30022# Joint Inst. for Nuclear Research, Dubna (USSR).
WEAK INTERACTIONS (THEORETICAL)
S. B. Treiman [1964] 23 p refs Submitted for Publication Revised
(JINR-E-1856; Conf-550-90)

Developments relating to the theory and understanding of weak interactions and symmetry groups are reviewed. Decay of long-lived neutral K-particles is discussed, and CP violations are considered in this framework. Findings relating to leptonic, semileptonic, and nonleptonic processes are included. High energy neutrino reactions, induced pseudoscalar in μ-capture, and the Cabibbo model are considered under semileptonic reactions. The possible role of SU a pure symmetry method, and universality and intermediate bosons are discussed. A field theoretical approach to weak interactions is presented, including discussions of W-theory and F-theory. M.W.R.

N65-30055# Michigan Univ., Ann Arbor. Dept. of Physics.
PRECISION MEASUREMENTS OF GAMMA-RAY ENERGIES UP TO 2 MeV USING A 2-METER CURVED-CRYSTAL MONOCHROMATOR
J. J. Reidy and M. L. Wiedenbeck 1965 24 p refs
(Contract AT-(11-1)-1112)
(TID-21830)

Precision measurements of gamma-ray energies up to 2 MeV were performed using the U-M 2m curved-crystal monochromator. Effective source activities of less than 40 mCur were used for the measurements of the transitions in the 2 MeV region. In the 150 keV region, effective source activities of less than 200 Cur may be used. Measurements have been performed on the transitions of energies less than 2150 keV which follow the decay of In^{116}(54 min), Mn^{54} (2.6 h) and Sc^{46}(85 d). In addition, results are presented which indicate that the reflection coefficient is approximately linear with respect to wavelength for the second order reflection from the germanium (022) planes in the region of 6–90 mÅ (2000-135 keV). Author

N65-30058*# Oak Ridge National Lab., Tenn.
RAPID COMPUTATION OF SPECIFIC ENERGY LOSSES FOR ENERGETIC CHARGED PARTICLES
R. W. Peelle 29 Apr. 1965 19 p refs
(NASA Order R-104; Contract W-7405-ENG-26)
(NASA-CR-64139; ORNL-TM-977) CFSTI: HC $1.00/MF $0.50 CSCL 20H

A method is demonstrated for computing rapidly in a digital computer the specific energy loss of energetic charged particles, excluding electrons. For energies larger than an empirically determined cutoff TLIM, the computation is based on use of the usual Bethe–Bloch equation with a "shell correction" for nonparticipation of tightly bound electrons in the absorber atoms, but without a "density effect" correction which might be required for incident proton energies as high as 1 GeV. Rapid computation is achieved by interpolating a combined shell correction from a small table of values stored with the set of parameters peculiar to a given absorber material. The accuracy is limited to a few tenths of a percent by the coarseness of the interpolation procedure and by the accuracy of the combined shell corrections presently available to serve as a base for interpolation. For incident energies less than TLIM, a plausible value is computed based wholly on a few empirical parameters. The results are compared against published tabulations of specific energy loss and against a very small selection of experiments on relative energy loss and range. A computer subprogram which utilizes the described technique is listed in the IBM-7090 FORTRAN-II language, and brief instructions for its use are given. Author

N65-30059# Maryland Univ., College Park. Dept. of Physics and Astronomy.
CHARGE EXCHANGE SCATTERING OF LOW ENERGY "K" MESONS IN HYDROGEN
Gerald S. Abrams and Bice Sechi-Zorn Mar. 1965 17 p refs *Its* Tech. Rept. No. 441
(Contract AT(40-1)-2904)
(TID-21734)

The momentum dependence of the cross section for the reaction $K^- + p \to \bar{K}^0 + n$ has been determined. The data are analyzed in terms of an effective range approximation to the $K^- - p$ phase shifts. A comparison is made to other studies of low energy $K^- - p$ interactions, and the data used to infer the existence of a KN S-wave bound state. Author

N65-30060# California Univ., Berkeley. Lawrence Radiation Lab.
ON THE HEAVY ISOTOPES OF HYDROGEN AND THE NEUTRON
N. A. Vlasov and L. N. Samoilov Feb. 1965 16 p Transl. into ENGLISH from Atomnaya Energ. (Moscow), no. 17, 1964 p 3-9
(UCRL-Trans-1183)

This paper treats the latest experimental data on the states of the 4- and 5-nucleon nuclei. These data confirms the existence of three unbound excited states of He^4:

He^4(20.1 Mev, 0+, T = 0),
He^4(22. Mev, 2−, T = 0),
He^4(24-2b Mev, 1−, T = 1).

Accordingly, the isobaric nuclei of H^4 and Li^4 do not have bound states, and their lifetime is of the order of 10^{-22} sec. The nucleus of H^b also does not have bound states and decomposes into $H^3 + 2n$ with the energy $Q \geq 1$ Mev and the lifetime of the order of 10^{-22} sec. The report regarding the observation of radioactivity of 10^5 is erroneous. An analysis of the binding energy of the nuclei with certain masses indicates the absence of the bound state in the case of tetraneutron as well. The nuclei of H^4, H^6, and n^4, as well as the heavier isotopes of hydrogen and the neutron, are beyond the limits of stability in regard to nucleon-emission decay. Author

N65-30062# California Inst. of Tech., Pasadena.
OCTET ENHANCEMENT
Roger F. Dashen, Steven C. Frautschi, Murray Gell-Mann, and Yasuo Hara [1964] 13 p refs Presented at the Intern. High Energy Phys. Conf., Dubna, USSR, Aug. 1964
(Contract AT(04-3)-41)
(CALT-68-2; CONF-550-92)

A simple universal current-current theory of weak interactions now accounts fairly well for all weak phenomena except the nonleptonic $|\Delta I| = 1/2$ rule, which presumably should be generalized to a unitary octet rule, covering not only the familiar $|\Delta Y| = 1$ nonleptonic interactions but also the $|\Delta Y| = 0$ nonleptonic interactions (for which experimental evidence in heavy nuclei has been presented by Boehm and Kankeleit). One may account for the octet nonleptonic rule either (a) by a theory that adds extra current-current products for strongly interacting particles alone, or else (b) by a dynamical mechanism that enhances octets by means of strong interactions. It is interesting that we can distinguish any reasonable theory of type (a) from any theory of type (b) by the amount of $|\Delta I| = 1$ in the $\Delta Y = 0$ nonleptonic interaction; the $|\Delta I| = 1$ component is large in the former case and small in the latter case. Difficult experiments involving light nuclei may be able to resolve the two possibilities. Author

N65-30097# C-E-I-R, Ltd., London (England).
THE USE OF MATHEMATICAL PROGRAMMING IN THE CALCULATION OF ATOMIC WAVE FUNCTIONS Final Technical Report
D. F. Mayers and F. O'Brien Wright-Patterson AFB, Ohio, ARL, Mar. 1965 80 p refs
(Contract AF 33(615)-1339)
(ARL-65-51; AD-617705)

The observed energy levels for Silicon + 3 have been fit by adding a polarization term to the potential of the Hartree-Fock equation in a manner first used by Douglas. The resulting wave functions were used to calculate transition integrals for the allowed transitions and compared with the results using no polarization term; the differences were of the order of a few percent. Results of calculations done on Silicon + 2 to determine the form of the polarization term for the two-electron case are reported. The isoelectronic sequence from Sodium to Argon + 7 was examined to determine the possibility of predicting polarization functions without knowledge of observed energy levels; difficulties in making the prediction are discussed. Changes in the numerical procedure for solving the Hartree-Fock equations are presented along with changes in the program for adding the polarization term. Author

N65-30104# C-E-I-R, Ltd., London (England).
THE CALCULATION OF ATOMIC WAVE FUNCTIONS BY SOLUTION OF THE HARTREE-FOCK EQUATIONS
D. F. Mayers and A. J. Hirsch Wright-Patterson AFB, Ohio, ARL, Apr. 1965 295 p
(Contract AF 33(601)-7261)
(ARL-65-62; AD-617703)

This report describes a program prepared for the IBM 7090 to solve the general form of the Hartree-Fock equations. The whole program is written in FORTRAN II except for three subroutines which are written in the FAP language. It is divided into four parts which contain: (1) Basic theory and method of numerical solution; (2) User's guide to the program; (3) subroutine specifications; and (4) flow diagrams and listing. Author

N65-30165# Space Technology Labs., Inc., Redondo Beach, Calif.
QUANTUM THEORY OF INTENSE PHOTON BEAMS Final Report
Lee M. Frantz Jun. 1965 64 p refs
(Contract DA-31-124-ARO(D)-213)
(STL-4165-6003-RU-000; AD-617527)

A formal expression has been derived for the field theoretic transition amplitude in a Brillouin-Wigner perturbation expansion. The principal innovation is the use of wave packets to introduce the boundary conditions, thereby avoiding the need for invoking the adiabatic hypothesis. To simplify the description of the free wave packets we have secondquantized only the field of incident particles, but not the scatter. No restrictions have been placed on the number of incident quants. The resulting expression is thus appropriate, for example, to the nonrelativistic description of the scattering of a photon beam of arbitrary intensity by an atom. The derivation consisted first of producing a set of formally exact scattering eigenvectors, then forming a time-dependent solution to the Schroedinger equation from a weighted superposition of them. An asymptotic expansion of the wave function in reciprocal powers of the time was then developed, and it was shown to have the form, in the remote past and future, of a free wave packet of quanta spatially isolated from the scatterer. The transition amplitude was then identified by a comparison of the initial and final-state wave packets. It was found to be a superposition of elements of the usual Brillouin-Wigner T-matrix, each weighted by the corresponding weight factor in the initial-state wave packet. Author

N65-30172# Commissariat a l'Energie Atomique, Saclay (France).
ACTIVATION ANALYSIS WITH PARTICLE ACCELERATORS [L'ANALYSE PAR ACTIVATION AUPRES DES ACCELERATEURS DE PARTICULES] Bibliography
Micheline Berton Dec. 1964 61 p refs In FRENCH and ENGLISH
(CEA-BIB-50)

N65-30177# United Kingdom Atomic Energy Authority, Harwell (England).
ABSOLUTE DETERMINATION OF THE ROENTGEN UNIT IN THE ^{60}Co GAMMA RADIATION ENERGY RANGE USING CAVITY IONIZATION CHAMBERS

A. Rakow and W. Will Jun. 1964 25 p refs Transl. into ENGLISH from Kernenergie (Dresden), v. 6, 1963 p 496-504, 546–552
(NP-TR-1206)

A dosimeter comparison in the energy range of the Cobalt-60 gamma radiation showed differences of up to 30 percent in the readings of measuring instruments of various makers used for dose determination during irradiation with ^{60}Co gamma-radiation in the hospitals and departments of the German Democratic Republic. Some cavity ionization chambers were therefore constructed of graphite and aluminum, and these enabled an absolute determination of the roentgen unit to be carried out. The corrections necessary for the dose determination concern the electron stopping power, the attenuation of primary radiation, contributions from scattered radiation, variations in intensity across the effective chamber volume, and density and humidity of the air; their determination is described. Estimation of the errors present shows that the cavity chambers allow a dose determination with a maximum error of about 2 percent. Comparision with an earlier measurement of the output of a Theratron-Junior installation at the National Research Council of Canada showed a deviation of only 0.9 percent. Author

N65-30180# Harvard Univ., Cambridge, Mass. Dept. of Physics.
RESEARCH IN HIGH ENERGY NUCLEAR PHYSICS
Annual Summary Report, 1 Oct. 1963–30 Sep. 1964
30 Dec. 1964 14 p refs
(Contract AT(30-1)-2752)
(HUX-2752-1)

Various areas of research in high energy nuclear physics are reviewed. These include: (1) *Production of Wide-Angle Electron Pairs and Pion Pairs*—Measurement of the number of electron and positron pairs which were produced at a large angle in a configuration such that there was symmetry about the direction of the incident gamma ray is described. (2) *Polarized Targets*—Studies have been made of the possibility of direct thermodynamic polarization of nuclear targets using low temperatures, and should enable construction of pure hydrogenic targets with aligned spins. (3) *Photoproduction Studies Using Liquid Hydrogen Bubble Chambers and Wide-Gap Spark Chambers*—Results constitute a comprehensive account of meson and hyperon production by photons between 0.5 and 5 Bev. (4) *The Scattering of Electrons, Positons, and Muons*—Investigation showed that the electromagnetic form factors continue to fall with increasing 4-momentum transfer. Also shown is the use of wide gap spark chambers with an insensitive region in the middle which will enable an electron beam or photon beam to pass through readily. (5) *PDP-1 Computer System Development and Application*—A time sharing system was developed for lowest priority, higher priority, and highest priority users having pre-assigned precedence. W.M.R.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-29242# Princeton Univ., N. J. Plasma Physics Lab.
A MICROWAVE SYSTEM FOR LOW DENSITY MEASUREMENTS
A. M. Levine, A. F. Kuckes, and A. Skislak Jul. 1965 9 p refs
(Contract AT(30-1)-1238)
(MATT-369)

A simple microwave system for measuring very low densities is described. The system consists of a double pass bridge with a phase locked detection scheme. The system, built for use on the Q-3 machine, has a noise level below 0.05° with an integration time of 0.2 sec. Absolute density measurements were made by mechanically chopping the plasma and observing the phase shift by the presence of the plasma. The density measurements were proportional to the ion saturation current to a probe. The microwave densities were a factor of 2 lower than the usual value quoted from ion saturation current measurements. The bridge was used in detecting small changes in density as the plasma electrons were heated. At a density of 10^{11} it can detect a 1% change in density. R.N.A.

N65-29456*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
AN INTEGRAL EQUATION APPROACH TO THE PLASMA SELF CONSISTENT FIELD PROBLEM
Peter M. Livingston 3 Sep. 1964 34 p refs
(Grant NsG-275-62)
(NASA-CR-59131: WIS-TCI-64) CFSTI: HC $2.00/MF $0.50 CSCL 20I

The self consistent field problem of a collisionless, fully ionized, single component plasma is treated by means of a Green's function technique. A formal perturbation series solution to the Liouville equation is then considered in the limit of large number and volume. For a problem time scale of the order of the inverse plasma frequency, only the terms in the perturbation series describing the collective interaction survive the limiting process, and therefore a time-reversible, hierarchy on integral equations is recovered for the various orders of the distribution functions. The nonlinear integral Vlassov equation follows from the first member of this hierarchy and a factorization assumption on the initial distribution function. An approximate solution to the Vlassov equation is developed in terms of the solutions to the linearized form of this equation. After defining the inverse dielectric function by the relationship between the dressed and free electron number densities, a correction term of the order e^2 to the usual linear theory result is found. N.E.A.

N65-29478*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LOCAL RESONANCES OF A PLASMA IN A MAGNETIC FIELD
Peter A. Sturrock (Stanford Univ.) [1964] 6 p refs Submitted for Publication
(NASA-TM-X-51936) CFSTI: HC $1.00/MF $0.50

Unexpected experimental results with the Alouette topside sounder have been attributed to resonances of the surrounding plasma. These observations are explained on the basis of the wave theory of a uniform plasma at nonzero temperature in a magnetic field. Electrostatic resonances are discussed, and the theory is outlined. Resulting estimates indicate that the plasma resonance would be observable for about 10 sec and the other electrostatic resonances for longer times; the resonances are in fact observable for only one to 10 msec. Since this rapid damping cannot be explained by electron collisions, it is attributed to the velocity of the satellite relative to the plasma. Finite satellite velocity, therefore, must be included in any extension of the theory as outlined. M.W.R.

N65-29481*# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
GAS-TRIGGERED PINCH DISCHARGE SWITCH

Robert G. Jahn, Woldemar F. von Jaskowsky, and Albert L. Casini Jul. 1964 7 p refs *Its* Tech. Note 101 Submitted for Publication
(Grant NsG-306-63)
(NASA-CR-58415) CFSTI: HC $1.00/MF $0.50 CSCL 20I

The design and performance of an inverse gas triggered pinch discharge switch are described. The electrodes are plane circular discs of aluminum separated by two concentric plexiglass insulators which define an annular discharge gap. Twelve radial holes are drilled through the inner insulator through which the discharge gap is evacuated and then triggered by a pulse of gas. The concentric return conductor is separated from the electrode edges and outer plexiglass cylinder by a teflon sleeve which extends into the external coaxial leads to the load and to the source. The operational sequence consists of the evacuation of the switch gap to a pressure below the Paschen limit for argon, the subsequent charging of the capacitor bank to the desired voltage, and the symmetrical injection of a small amount of argon through the radial ports in the inner insulator into the discharge gap. As the gas density rises past the Paschen limit, a diffuse breakdown precipitates over the entire gap ring. The switch stabilizes at a resistance of 5×10^{-3} ohms and an inductance of 3×10^{-9}H, and displays a minimum of initiation noise and electrode damage. R.N.A.

N65-29651*# Stanford Univ., Calif. Radioscience Lab.
OBSERVATION OF A VERY LOW FREQUENCY PLASMA RESONANCE BY ALOUETTE I
N. M. Brice and R. L. Smith [1964] 4 p refs
(Grant NsG-174)
(NASA-CR-58611) CFSTI: HC $1.00/MF $0.50 CSCL 20I

A discussion is presented on an unusual band of noise observed in the Alouette I satellite. This hiss band has a sharp lower frequency cutoff which increases in frequency with decreasing lattitude of the satellite. Various characteristics of hiss band were deduced from observations and it was suggested that it arises from a plasma resonance at very low frequencies. The only resonance for low frequencies at the satellite height is the lower hybrid resonance which defines a cutoff frequency for propagation transverse to the earth's magnetic field. Other features of this resonance support the hypothesis that the lower cutoff frequency of the Alouette hiss band is the lower hybrid resonance for the ambient plasma. This hiss band may provide a powerful diagnostic tool for determining the ionic constituents of the plasma surrounding satellite. R.N.A.

N65-29669# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
PLASMA COUPLING MEDIUM FOR A TRAVELING-WAVE TUBE AMPLIFIER
Verle A. Gilson and Curtis C. Johnson Jul. 1965 162 p refs
(Grants NSF G-15017; NSF GP-843; NSF GK-29)
(NSF-9)

The effects of a plasma medium in an axial d-c magnetic field on Pierce's beam coupling impedance of a traveling-wave tube are investigated. This study treats the plasma's electron cyclotron frequency as a primary variable and the plasma frequency as a parameter. A disc-loaded waveguide with the plasma filling the hole region was selected for the slow-wave circuit. Theoretical calculations for the configuration show that the beam coupling can be greatly enhanced when the cyclotron frequency is near but greater than the applied frequency. The amount of increased coupling is dependent upon the relative size of the plasma frequency with respect to the applied frequency but substantial amounts are predicted when the plasma frequency is significantly less than the applied frequency. Experimental results are included. Author

N65-29798# Los Alamos Scientific Lab., N. Mex.
THE POWER CROWBAR ENERGY SYSTEM FOR SCYLLA IV
E. L. Kemp and W. E. Quinn 10 Mar. 1965 21 p refs
(Contract W-7405-ENG-36)
(LA-3189-MS) CFSTI: $1.00

The energy storage system of Scylla IV has four capacitor banks which are applied in the following order: a) the reverse bias bank—10-kV, 280-kJ, with a rise time of 60 μsec; b) the preionization bank—40-kV, 9-kJ, that rings at 300 kc; c) the primary bank—50-kV, 540-kJ, with a rise time of 3.7 μsec; and d) the power crowbar bank—20-kV, 3-MJ, with a rise time of 25 μsec. The first three banks have been in operation for over a year, and their performance will be discussed. The main problem with the power crowbar bank is the switch. The characteristics of each switch will be discussed, and the choice of the vacuum switch will be discussed in detail. The discussion will also include the various methods of triggering vacuum switches. A washer gun was chosen as the trigger for each gap. This gun will be shown and discussed. The 3-MJ capacitor bank will be discussed as a system, including the capacitor protection scheme, the prefire protection circuit, and the complete firing system. Author

N65-29903# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
A KINETIC THEORETICAL INVESTIGATION OF A FULLY IONIZED GAS. PART II: SOME ASPECTS OF MULTIPLE COLLISIONS
Toyoki Koga Jan. 1965 79 p refs
(Contract Nonr-839(38))
(PIBAL-863, Pt. II; AD-464742)

The Brownian motion of a test body due to multiple interactions with field particles is investigated within or almost within the framework of Markoff's processes. Based on Markoff's method of random flights, we investigate the Brownian motion of an elastic test body submerged in a rarefied gas constituted of elastic molecules, under the condition that *mutual interactions among field particles are negligible*. It is shown that there is no difference in effect between temporal repetitions of random binary collisions and multiple collisions (random binary collisions superposed at one moment of time), *so far as the friction and diffusion of the test body in momentum space are concerned*. It is not feasible, however, to ignore those mutual interactions of field electrons and to represent electronic multiple interactions by temporal repetitions of random binary interactions, each of which takes place independently: Fluctuations of limitlessly large amplitudes in the spatial distribution of electrons, which may possibly take place in this approximation, do not seem realistic, because a limitless concentration of potential energy accompanying a concentration of electrons in a local spot cannot be permitted. Amplitudes of such fluctuations and/or microscopic disturbances must have a certain maximum limit. A kinetic theoretical scheme of treating fully ionized gas in light of this fact is proposed. Author

N65-30005# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LOW-TEMPERATURE PLASMA GENERATORS
S. A. Khristianovich and M. Yu. Zhukov 14 May 1965 9 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 6, 1964 p 21–25
(FTD-TT-65-63/1+2; AD-616310)

Plasmatrons, or low-temperature plasma generators, have been developed to heat gases and vapors to temperatures of 6000° K and higher using an electric arc with ac or dc current. An illustrated plasmatron, designed with eddy gas stabilization of the electric arc, consists of two hollow copper cylindrical electrodes arranged coaxially and cooled by water or the medium itself. The electrodes are separated by an insulated eddy chamber. A form of breakdown of the internal surface of the output electrode is illustrated, and volt-ampere characteristics of the arc and arc burning are graphed. Plasmatrons such as the one mentioned can be used for the synthesis of products accompanied by a great amount of energy absorption, or as high temperature heaters for wind tunnels. M.W.R.

N65-30008# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
VARIABLE CONDUCTIVITY MFD COUETTE FLOW
Kenneth R. Cramer Jan. 1965 60 p refs
(ARL-65-13; AD-616354)

Couette flow of a conducting fluid subjected to magnetic and electrical fields is examined for several continuous and discontinuous electrical conductivity profiles to estimate the importance of nonuniform conductivity on the fluid-dynamic variables. The velocity field, flow rate and shear at the moving surface are moderately changed and the shear at the stationary surface is greatly increased as the conductivity becomes more nonuniform. For a given profile, only minor differences occur when less than a fourth of the fluid is nonconducting. The separation pressure can be significantly increased by an external electrical field even when a large portion of the fluid is nonconducting. Stronger magnetic and electrical fields magnify the influence of nonuniform conductivity. Major errors may occur from the assumption of uniform electrical conductivity. Author

N65-30068# General Applied Science Labs., Inc., Westbury, N. Y.
ELECTROMAGNETIC STUDIES IN SHOCK PRODUCED PLASMAS Final Report
R. Tomboulian 15 Apr. 1965 178 p refs
(Contract Nonr-3475(00)); ARPA Order 207-62)
(TR-519; AD-616272)

This report represents a compilation of the important aspects of an analytical and experimental study concerned with non-uniform plasmas. The information presented represents a summary of the physical problem and the methods of solutions. The experimental work was done using a shock tube to produce the plasma. A detailed description of the shock tube facility is presented. An integral part of the work done on this contract has been the development of a spatially resolving electron density microwave diagnostic technique useful in the range of electron densities infrequently explored by other investigators. The microwave instrumentation for this technique is described in detail. A summary of the theoretical work conducted in conjunction with the experimental program is presented. N.E.A.

N65-30095# Brown Univ., Providence, R. I. Div. of Engineering.
REFLECTION OF ELECTROMAGNETIC WAVES FROM INHOMOGENEOUS PLASMA Scientific Report No. 6
Chao Han Liu and Lewis Wetzel Jun. 1965 81 p refs
(Contract AF 19(628))-2498)
(AF-2498/6; AFCRL-65-334; AD-617619)

This paper deals with the problem of reflections of electromagnetic waves and signals from an inhomogeneous, lossy, dispersive, anisotropic medium. Discussion is mainly confined to one dimensional stratified medium and high frequency waves. The medium can be either a dielectric or a plasma region. It is shown that the weak reflections are essentially independent of the character of the curvature of refractive index in the transition region between two different gradients, thus the bulk effect if more important. An integral equation is derived from the wave equation and from it, a variational expression is obtained for the correction term to the WKB approximation result for the reflection coefficient. The reflection of a turned-on sine signal from a plasma medium is considered. Analytic expressions for the reflected signals for the two normal modes of longitudinal propagation in an anisotropic plasma are also derived. For numerical calculations, typical ionosphere data are used. Author

N65-30178# Institut für Plasmaphysik G.M.B.H, Garching (West Germany).
ABSORPTION COEFFICIENT OF RUBY-LASER RADIATION IN FULLY IONIZED LIGHT ELEMENTS
Heinrich Hora Sep. 1964 20 p refs
(IPP-6/27)

Starting from the linearized macroscopic equations of the two-fluid-model, the absorption coefficient and refractive index of a fully ionized plasma are calculated for atomic numbers $Z = 1$ to 10, electron temperatures $T = 10^1$ to near 10^6eV, atomic densities $N = 10^{17}$ to 10^{23}cm^{-3}, and for a light frequency $\omega = 2{,}71 \cdot 10^{15}$sec (ruby laser). A linear interaction between field and plasma is assumed. Although only the D.C. collision frequency is used, the resulting optical constants are in good agreement with Dawson's and Oberman's values (based on a microscopic theory), and with absorption coefficients calculated from bremsstrahlung theory. In the latter case the light frequency must be much higher than the plasma frequency, and an agreement is only possible, when stimulated emission is taken into account in the bremsstrahlung calculations. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-29193# Library of Congress, Washington, D. C. Aerospace Technology Div.
RARE-EARTH METALS AND THEIR COMPOUNDS AS MATERIALS FOR THERMIONIC CATHODES [REDKOZEMEL'NYYE METALLY I IKH SOYEDINENIYA KAK MATERIALY TERMOELEKTRONNYKH KATODOV]
B. V. Bondarenko and B. M. Tsarev 7 Jul. 1965 11 p refs
Transl. into ENGLISH from Tr. Inst. Met. Akad. Nauk SSSR (Moscow), 1964 p 86–91
(ATD-T-65-45; AD-466288)

Physical and chemical, emissive, thermionic, and secondary electron emission properties of rare earth metals (REM) and their compounds are analyzed in reference to use for electrodes and cathodes. Results of emission investigations on oxides of REM are tabulated and reveal two states of activity, one being stable. The minimum values of the work function in the stable state are within 2.9 ± 0.15 ev, and within the limits of 2.75 ± 0.2 ev in the state of maximum activity. Some results of secondary electron emission of REM hexaborides are also given. C.T.C.

N65-29214# Stanford Research Inst., Menlo Park, Calif.
A SUMMARY OF THE SOVIET PAPERS ON THE HIGH PRESSURE EQUATION OF STATE OF METALS
Gordon D. Anderson 15 Jun. 1965 59 p refs
(TR-003-65)

A summary of Soviet papers is presented on the shock compression of metals in which fantastically high pressures and projectile velocities are reported. A description of experimental methods, handling of data, and the equation of state models used to describe the behavior of metals at high pressures and temperatures are included. Experimental data such as measured shock velocities and flying plate velocities and quantities computed directly from these data by the Rankine–Hugoniot jump conditions are presented in appendix A. On the basis of particular equation of state models suggested by the experimental data, thermodynamic quantities such as 0° K isotherms, Gruneisen functions, and shock temperatures are calculated. These calculated results, as distinguished from direct experimental data, are presented in appendix B. R.N.A.

N65-29241# Maryland Univ., College Park. Dept. of Physics and Astronomy.
THE CONDUCTIVITY OF MAGNETIC CONDUCTORS
Edward A. Stern (Naval Ordnance Lab.) May 1965 28 p refs
(Contract ARPA SD-101)
(TR-458)

The response of the conduction electrons in magnetic metals neglecting collisions with the lattice is considered. The Lorentz force for the conduction electrons is given by the same expression as for non-magnetic metals with $\underline{B} = \underline{H} + 4\pi\underline{M}$ replacing H. The spin-orbit interaction in conductors with a net spin polarization produces a polarization of the spacial part of the electronic wave functions which gives a new contribution to the current as calculated in the Boltzmann equation which is not present in non-magnetic metals. This new contribution is given by the time derivative of the polarization. The polarization contribution to the conductivity is shown to become appreciable only for infrared and higher frequencies. It is shown that the usual quantum mechanical explanation of the Faraday rotation in terms of a sum over interband matrix elements is equivalent to the more physical one given here and the frequency dependence of the Faraday effect can be understood as a frequency dependence of the polarization of the wave functions. Author

N65-29257# Naval Radiological Defence Lab., San Francisco, Calif.
A HIGH PRECISION SYSTEM FOR MEASURING SEEBECK COEFFICIENT, ELECTRICAL RESISTIVITY, AND HALL COEFFICIENT IN INHOMOGENEOUS THERMOELECTRIC MATERIALS
J. W. Winslow, R. R. Hart, and J. C. Boteler 18 May 1965 47 p refs
(USNRDL-TR-850; AD-466523)

This report presents a discussion of problems encountered and solutions developed during the design, construction, and testing of an apparatus for making high-precision measurements of Seebeck coefficient, S, electrical resistivity, ρ, and Hall coefficient, R, in single samples of a number of inhomogeneous, compound semiconductors, over the temperature range from 77° K to ca 500° K. The final design, which is described in detail, was tested for precision under the condition that samples were removed from and remounted in the apparatus between measurements. Under this condition, the variations in remeasuring S and ρ for eleven materials were found to be not larger than ±5%. A detailed analysis of the data observed for an Alumel sample is presented. Also under this condition, the variation in remeasuring R for one sample of single-crystal bismuth telluride was found to be not larger than ±2%. These data also are presented. Author

N65-29262# Stanford Univ., Calif. Microwave Lab.
MEASUREMENT OF MICROWAVE ACOUSTIC ATTENUATION IN SAPPHIRE AND RUTILE USING NICKEL FILM TRANSDUCERS Scientific Report No. 3
R. A. Wilson, H. J. Shaw, and D. K. Winslow May 1965 19 p refs Revised
(Contract AF 19(628)-342)
(ML-1253; AFCRL-65-2; AD-465933)

Initial investigations on the room temperature acoustic attenuation in sapphire and rutile at S-band, which were reported earlier, showed the attenuation in both of these materials to be relatively low. These measurements have now been extended to other frequencies, and curves of attenuation are shown for rutile shear waves and sapphire longitudinal waves covering the frequency range from L-band to X-band, and for sapphire shear waves from L-band to S-band. The attenuation has a nearly linear variation with frequency at the lower frequencies, and increases monotonically as frequency increases. This behavior may be attributable to Rayleigh scattering from sub-micron scattering centers within the crystals. Nickel film magnetostrictive transducers, coupled to dielectric resonators, were used to generate the acoustic waves in the samples under study, and the acoustic attenuation was determined from echo measurements. Conversion efficiencies and certain other observed properties of nickel film transducers over the above frequency ranges are also discussed. Author

N65-29277# Maryland Univ., College Park. Dept. of Physics and Astronomy.
FARADAY EFFECT IN MAGNETIZED SOLIDS
Edward A. Stern May 1965 9 p refs
(Contract ARPA SD-101)
(TR-461)

Measurement of the Faraday rotation in PbS made previously revealed that the wavelength variation of the Faraday rotation below interband frequencies has a constant added to the usual λ^2 dependence. This constant term varies approximately inversely proportional to the temperature. It is shown that the constant term comes from a polarization current produced by the variation in time of the spacial polarization of the electron wave functions, and that this term is expected to be proportional to the magnetization of the sample. The effect of collisions with the lattice is also estimated. E.E.B.

N65-29290# Los Alamos Scientific Lab., N. Mex.
A REVIEW OF QUASIPARTICLE AND JOSEPHSON TUNNELING IN SUPERCONDUCTORS
Robert Brout 13 Jul. 1965 58 p
(Contract W-7405-ENG-36)
(LA-3342-MS) CFSTI: $3.00

After a brief treatment of the general theory of quantum-mechanical tunneling, this report gives a review of electron tunneling which occurs across metal-insulator-metal junctions, with emphasis on the cases where one or both metals are superconductors. Quasiparticle tunneling is first described by means of a phenomenological approach resembling that used in the theory of electrons tunneling into semi-conductors. Then the important features of quasiparticle tunneling are developed using a more refined, microscopic theory, and the predictions are compared with the results of published experimental work. Finally, the theory of Josephson tunneling is

treated in detail, and the important effects—d.c. current, presence of external field, Josephson skin depth, a.c. potential effect—are discussed along with experiments. Author

N65-29501 North Carolina Univ., Chapel Hill.
RADIATION DETECTION IN LARGE CRYSTALS OF SILVER CHLORIDE: A SURVEY AND REPORT OF RECENT EXPERIMENTS
Charles B. Childs and Lawrence M. Slifkin *In* CERN Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. 1 Jan. 1965 17 p refs (See N65-29500 18-24)
(Contract ARPA SD-100; Grant AF-AFOSR-450-64)

Described is a technique which employs the use of large single crystals of silver chloride for radiation detection. The technique involves the deposition of electrons at defect sites throughout the volume of crystals of the order 1 cm × 1 cm × 0.5 cm. Because of the great mobility of interstitial silver ions, each trapped electron gives rise to an atom of metallic silver which, upon repeated acquisition of electrons and silver ions, grows into a microscopically visible speck of silver metal; thus yielding a delineation of imperfect regions throughout the crystal by decoration. Discussed are the potential advantages of the method in comparison with emulsion techniques. Included is a brief survey of radiation damage phenomena and of the decoration process. Also presented is a review of experimental results obtained with silver chloride detectors, and a discussion of unsolved problems and current experiments. S.C.W.

N65-29502 General Electric Co., Schenectady, N. Y. Research Lab.
CHARGED PARTICLE TRACKS IN SOLIDS AND THEIR APPLICATIONS TO NUCLEAR PHYSICS AND GEOPHYSICS PROBLEMS
R. M. Walker *In* CERN Proc. of the 5th Intern. Conf. on Nuclear Phot., Vol. 1 Jan. 1965 7 p refs (See N65-29500 18-24)

Presented is an abstract of a paper in which basic experimental phenomena of charged particle tracks in solids were reviewed, and the mechanism of formation in tracks discussed. Also summarized were the special advantages of these new particle detectors for nuclear physics studies. Illustrated was the successful use of solid-state track detectors in nuclear physics experiments. It was shown that natural crystals contain fossil tracks; and data were presented on the origin and specific applications of fossil tracks to studies of terrestrial minerals, meteorites, and cosmic rays. The future possibilities of research on charged tracks in solids were also discussed. S.C.W.

N65-29580# North American Aviation Science Center, Thousand Oaks, Calif.
A FUNDAMENTAL STUDY OF DEFECT-DISLOCATION INTERACTION IN NaCl TYPE LATTICES Final Report, Mar. 1, 1963–Feb. 28, 1965
R. Chang [1965] 68 p refs
(Contract Nonr-4063-00)
(AD-615974)

Effect of divalent metal impurity distribution, quenching rate, and annealing temperature on flow stress in ionic crystals (NaCl, LiF). The elastic interaction between dislocations and defects associated with calcium impurities in sodium chloride. Perturbation of the V2-band in Ca-doped KCl from elastic and plastic deformation. Optical probing of the environment of F centers in deformed alkali halides. Author

N65-29591# Atomics International, Canoga Park, Calif.
CALCULATIONS OF THE MADELUNG CONSTANT AND INVERSE TWELFTH POWER REPULSION FACTORS FOR THE WURTZITE CRYSTAL STRUCTURE
William G. Gehman [1965] 77 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11150)

The Madelung constant and the inverse twelfth power repulsion factor have been calculated for the wurtzite structure for wide ranges of the crystal parameters c_o/a_o and u (the u-parameter being a measure of the MX bond distance parallel to c_o). The Madelung constant for the known compounds AlN, BeO, and AgI, plus that for the hypothetical "ideal" wurtzite structure, are respectively 2.699, 2.686, 2.678, and 2.680. Minima are found for both the Madelung constant and the inverse twelfth power repulsion factors when they are plotted versus u for a fixed value of c_o/a_o. These extrema imply the existence of broad maxima in the electrostatic energy (E_e) and relatively steep minima in the repulsion energy (E_r) in a three-dimensional (c_o/a_o)–u–(potential energy) space. The maxima in E_e and the minima in E_r determine an "energy valley" in which the wurtzite compounds are constrained to lie. Author

N65-29825# National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON THE MEASUREMENT OF BULK RESISTIVITY OF SEMICONDUCTOR MATERIALS FOR ELECTRON DEVICES
Judson C. French 21 Oct. 1964 123 p refs
(ARPA Order 373-62)
(NBS-TN-232) GPO: $0.60

An annotated bibliography is presented on accurate measurements of the bulk resistivity of semiconductor materials such as germanium and silicon which are used in electron devices. Articles are included on ac and dc methods requiring probes or other contacts, ac contactless methods, microwave methods, epitaxial and diffused layer resistivity measurement, resistivity measurements at resistivities of 100 ohm-cm or greater, material properties, sample inhomogeneities and anisotropies, sample preparation and associated techniques, miscellaneous equipment and techniques, correction factors, mathematical principles, and error analysis. R.N.A.

N65-29826# Maryland Univ., College Park. Dept. of Physics and Astronomy.
FARADAY EFFECT AND FERMI SURFACES OF THE SILVER-GOLD ALLOY SYSTEM
A. J. Mc Alister, E. A. Stern, and J. C. Mc Groddy Jun. 1965 20 p refs
(TR-470)

Measurements of the polar reflection Faraday effect (PRFE) have been made in the visible and near infrared regions of the spectrum on three solid solutions of gold and silver, of 22.5, 47.0 and 71.5 atomic percent gold concentration. Since measurements are made at optical frequencies, the PRFE is not subject to the usual limitation of long electron lifetime, and is therefore applicable to non-dilute solid solutions. These measurements yield the first direct information on the Fermi surface geometry in non-dilute disordered alloys. Because both silver and gold are monovalent, have the same atomic size, and are miscible in all proportions, the changes in the Fermi surface can be related to changes in the effective lattice potential alone. The results indicate that Fermi surface contact area and shape vary linearly from pure silver to pure gold. This result confirms the assumption that such an alloy can be treated by averaging the potentials of the pure constituents, and indicates that the

symmetries of the conduction band wave functions at the center of the <111> zone faces are the same for both gold and silver. Author

N65-29889# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IRRADIATION ON THE SECOND OPTICAL HARMONICS
V. S. Mashkevich 12 May 1965 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 2, 1964 p 226-229
(FTD-TT-65-25/1; AD-617159)

Intense optical harmonics were obtained in crystals by laser irradiation. TAB

N65-29897# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.
ELASTIC CONSTANTS AND WAVE PROPAGATION IN ANTIMONY AND BISMUTH
Seymour Epstein and Alex P. DeBrettville, Jr. Mar. 1965 22 p refs
(ECOM-2577; AD-617102)

Ultrasonic wave velocites for 14 different modes were obtained on two differently oriented single crystal antimony cubes from the time between successive unrectified radio frequency pulse echoes. This redundant set of data was fitted by a least squares technique to Voigt theory to yield the six room temperature adiabatic elastic stiffness constants. Also included are a visual method of fixing the laboratory coordinate system in antimony by means of an imperfect cleavage plane, a calculation of the pure mode directions in the mirror plane, a simple formula for choosing the nonextraneous value for trigonal crystals having six independent elastic constants without resorting to lattice stability criteria, and a calculation of the deviation of elastic wave particle displacement and energy flux directions from the propagation direction. For waves propagating in the (0,1,1) and (0,$\bar{1}$,1) directions, the particle displacement deviations for antimony and bismuth do not exceed 15° and 13° respectively, and corresponding energy flux deviations up to 45° and 27° are obtained. Author

N65-29918# Army Electronics Labs., Fort Monmouth, N. J.
STUDIES OF FIELD EMISSION AND ELECTRICAL BREAK DOWN BETWEEN MICRON-SIZED AREAS
Hans Hieslmair Mar. 1965 17 p refs
(ECOM-2583; AD-617192)

In a modified "Müller" microscope capable of controlled movements of one electrode to an accuracy of several hundred Angstrom units, a polished nickel surface has been scanned with a micron-sized positive electrode (collector) at distances of several microns. First results indicate that at certain localized sites the emission current passes through a maximum while moving the collector approximately parallel to the polished nickel surface. The current-voltage characteristics of this emission current satisfies the Fowler-Nordheim equation thus indicating that field emission is involved. Some of the emitted electrons pass the rim of the collector and are accelerated towards a phosphor screen, where they produce a sickle-type emission pattern. In some cases several distinctly emitting sites could be observed from areas as small as $2 \times 10^{-5} cm^2$. Author

N65-29971# Naval Postgraduate School, Monterey, Calif.
NORMAL TO SUPERCONDUCTING TRANSITION TIMES FOR THIN FILMS OF TIN AND INDIUM
George L. Bower and Kenneth R. Simila (M.S. Thesis) 1964 52 p refs

The transition time from the resistive to the superconducting state for thin films of tin and indium was investigated under a variety of conditions. The purpose was to extend previous work which had shown that, when a thin film is switched to the normal state by a current pulse, the time required for the film to return to the superconducting state can sometimes be decreased by increasing the pulse amplitude. Thus the transition time is not a continuously increasing function of the current used to switch the film to the resistive state and hence cannot be entirely explained by joule heating and subsequent cooling by conventional heat transfer processes. The effects on the transition time produced by temperature, switching pulse duration, magnetic field and a silicon monoxide coating on the film were investigated. Author

N65-29983# Cornell Univ., Ithaca, N. Y.
NMR CALIBRATION OF SUPERCONDUCTING MAGNETS
B. W. Maxfield and J. R. Merrill 17 Feb. 1965 14 p refs *Its* Rept.-321
(NYO-2150-4)

This paper reports a method of absolute calibration for low homogeneity, superconducting solenoids for fields up to 85 kG. The method utilizes nuclear magnetic resonances at rf frequencies up to 95 Mc/s. The paper also reports some measurements of hysteresis in a superconducting solenoid which were measured using this technique. Author

N65-29986# Naval Postgraduate School, Monterey, Calif.
PARAMAGNETIC RESONANCE ABSORPTION OF PHONONS IN PINK RUBY
Grady A. Weeks (Ph.D. Thesis) 1964 60 p refs

The spin-phonon interaction in pink ruby has been studied at 1.4° K by measurement of the absorption spectra for 5.33 gc/s acoustic pulses. EPR spectra were also measured in the 12.4 – 18.0 gc/s band. Both the EPR and acoustic line shapes were found to be essentially Gaussian except for a small, previously unreported asymmetry. The line widths were also measured. The acoustic line width at 1.4° K was found to be 55 mc/s as compared to 90 mc/s for the EPR spectra. In addition, the EPR line width was found to be temperature dependent. A new theoretical model for the calculation of EPR line width contributions from isotropic exchange effects in the high temperature limit for magnetically dilute systems is presented. The calculated line width and the experimental line width agree within a few percent. Precision measurements of the energy level structure were also made for ruby over the temperature range from 1.4° K to 300° K. Significant temperature variation was found, despite the fact that the previously published energy level structure was given to five figures without indication of temperature variation. The literature values appear to need modification in the second or third figure in some temperature ranges. Author

N65-29988# Texas Instruments, Inc., Dallas.
NEW HIGH TEMPERATURE INFRARED TRANSMITTING GLASSES Fourth Semiannual Technical Summary Report, 1 Aug. 1964–30 Apr. 1965
[1965] 30 p refs
(Contract Nonr-3810(00))
(TI-08-65-72; AD-616115)

An investigation into the basic chemical and physical nature of the non-oxide chalcogenide glasses has been under way for the past few months. The glasses are found to be covalently bonded solids in which the nature of the parent chalcogenide is largely preserved. Within a few percent, the densities are a linear function of the molecular weight calculated from the compositional formula. Molar refraction and

refractive index can be estimated within a few percent from density, compositional formula, and the covalent radii of the constituent elements. The interatomic distances calculated from simple stretching vibrational frequencies are very close to the sum of the appropriate covalent radii. A study of the vapor over heated glasses of different compositions indicates the group VA elements in ternary systems are only loosely held in the glass structure and are not bonded to the chalcogenides in the presence of group IVA elements. A radial distribution analysis of the intensity of scattered X-ray energy as a function of angle of incidence for Si-Te glasses indicates the presence of evenly spaced Te chains. Author

N65-30011# Lowell Technological Inst. Research Foundation, Mass.
EFFECTS OF EXTERNAL FORCES ON VIBRATING CRYSTAL PLATES Seventh Quarterly Report, 1 Nov. 1964–31 Jan. 1965
Charles R. Mingins, Luther C. Barcus, and Robert W. Perry [1965] 49 p refs
(Contract DA-36-039-AMC-02239(E))
(Rept.-15; AD-615810)

Continued research has dealt with various aspects of the reactions of oscillating quartz piezoids to the external application of forces and torques. Additional experiments performed using tension applied in a variety of ways at the corners of square AT-cut plates have engendered a confidence in the interpretation of the character of the force field. A trend is reported in the values of the motional parameters as the tensional load is increased. Values of the tensile stress coefficients of frequency for the BT cut are established for circular and for rectangular plates, at = 0° and 90°, and for fundamental and overtone excitation. Comparisons are drawn with AT-cut cases. Preliminary experiments on the effects of producing a torsional stress are described. Marked progress in the theory of frequency deviation phenomena has been made by setting up the equations of motion of the plate including third-order terms, and working toward appropriate solutions. Author

N65-30038# Minnesota Univ., Minneapolis. Physical Electronics Research Lab.
RESEARCH IN PHYSICS OF ELECTRON EMISSION AND ELECTRON TUBE TECHNOLOGY Interim Report, 16 Oct. 1964–15 Apr. 1965
D. E. Anderson, A. B. Laponsky, and W. T. Peria ed. Wright-Patterson AFB, Ohio, Electron. Technol. Lab. [1965] 264 p refs
(Contract AF 33(657)-10475)
(IR-5; AD-615311)

Secondary emissions, thermionic emitters, multilayer thin film tunnel devices, surface properties and cleaning, alkali antimonides, and low energy electron diffraction theory were studied in connection with research in physics of electron emission and electron tube technology. A new tube structure for studying MgO and Al_2O_3 thin films was completed, and thin films of Ta_2O_5 on tantalum were produced by gaseous anodization. Thermal stability criteria are given for Fe_2O_3, and internal photoemission data are presented from thin film Al-Al_2O_3 metal diodes. Tubes built to study the emission capabilities of the nickelate cathode as a function of cathode life are described, and a comparison of diffraction results for Na-covered Ge and for Ge is included. Testing of an ion beam technique for sputter-cleaning Ge field emission cathodes is described. Results of the mass analysis of an Na atom source are presented. Studies of pyrolytic graphite and an improved LEED pattern are described. A distorted-wave type Born approximation is applied to the analysis of the coherent, elastic scattering of low energy electrons from a semi-infinite solid. M.W.R.

N65-30046# Brown Univ., Providence, R. I. Metals Research Lab.
GROWTH OF DISLOCATION-FREE GALLIUM CRYSTALS
S. H. Mc Farlane III and C. Elbaum Apr. 1965 27 p refs
(Contract Nonr-562(27))
(AD-616258)

Single crystals of gallium have been grown with large portions free of dislocations detectable by anomalous transmission of x-rays. The crystals are grown by an unconstrained solidification technique. The very small supersaturation of vacancies in gallium at room temperature precludes the possibility of vacancy condensation and disc collapse as a mechanism of dislocation formation. Therefore, the absence of dislocations can be explained by the careful growth procedure that minimizes the sources of dislocations usually present during crystal growth. Networks of dislocations can be generated by scratching the surface of the crystal. It is found that the image of a dislocation network at the exit x-ray surface is well resolved while the same network at the entrance x-ray surface produces a completely unresolved image. This effect is attributed to the "x-ray fan" or x-ray energy spread in the crystal perpendicular to the diffracting planes. Author

N65-30103# General Electric Co., Schenectady, N. Y. Research Lab.
RESEARCH INTO RADIATION DAMAGE EFFECTS IN SOLIDS Final Report, Apr. 1, 1962–Mar. 31, 1965
R. L. Fleischer, P. B. Price, and R. M. Walker Jun. 1965 34 p refs
(Contract AF 19(628)-369)
(AFCRL-65-305; AD-617784)

Almost all insulating solids, including natural minerals, glasses, and plastics record tracks of nuclear charged particles. After first describing the nature of tracks in solids and ways of seeing them, we show how they have been used in such diverse problems as measuring the age of geological and archeological specimens, studying the early history of the solar system recorded in meteorites, observing nuclear interactions, determining neutron fluxes, and separating biological cells of different sizes. Author

N65-30106# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
ELECTROMOTIVE FORCE INDUCED IN FERROMAGNETIC WIRE BY OSCILLATORY MAGNETIC FIELD PARALLEL TO THE WIRE
Roman Skorski Apr. 1965 31 p Transl. into ENGLISH from Prace Inst. Mech. Precyzy'jnej (Warsaw), v. 8, no. 29, 1960 p 1–12
(RSIC-400; AD-617550)

This article presents a schematic drawing and a principle of inducing an EMF in ferromagnetic wires by means of an oscillatory magnetic field parallel to the wire. Also presented is a table of chemical composition of the wires, the wire torsional twist effect on EMF, the wire magnetic field strength effects of length, diameter, and chemical composition on the character of EMF impulses, and of combining of EMF's of two wires having different ferromagnetic properties. Effects of a hard-drawn wire on the flow of impulses and of temperature, are also presented. Final results are given. Author

N65-30126# Naval Ordnance Lab., White Oak, Md.
ON THE THERMAL EXPANSION AND STRUCTURE OF ANISOTROPIC MONATOMIC SOLIDS
D. John Pastine 17 Jun. 1965 76 p refs
(NOLTR-65-22; AD-618056)

An explanation is given for the anisotropy of both the structure and thermal expansion of certain monatomic crystals.

Only those crystals are considered which have a face centered tetragonal structure with four atoms per unit cell. The anisotropic properties are explained by the introduction of an effective atomic pair interaction which is itself anisotropic. The interaction energy, ϕ, between any two atoms of the crystal is assumed to be of the form $\phi = -A'/R^m(1 + \epsilon' P_2) + B'/R^n$, where R is the distance between the atoms, A', B', m, n, and ϵ' are constants, and $P_2 = -1/2(1 - 3\cos^2\theta)$, where θ is the angle between the line joining the two atoms and one of the principal axes of the crystal. This interaction is summed over all pairs in order to obtain the total energy, U, of the crystal at the absolute zero of temperature. The contribution to the energy of the zero °K lattice vibration is neglected. The structural anisotropy is then seen to result from the condition that U be an absolute minimum at zero pressure. This structural anisotropy is found to depend only on the value of ϵ' and disappears completely in the case $\epsilon' = 0$. With the structure given, the linear thermal expansion is calculated along the principal axes of the crystal. Computation is made possible by expressing the three isobaric linear thermal expansion coefficients in terms of the interaction energy. The anisotropy of the thermal expansion is likewise found to depend only on ϵ' and to disappear in the case $\epsilon' = 0$. Author

N65-30146# Motorola, Inc., Phoenix, Ariz. Semiconductor Div.
ACTIVE ACOUSTIC DEVICES Second Quarterly Report
N. G. Sakiotis, W. H. Brendecke, and F. S. Hickernell Griffiss AFB, N. Y., RADC, May 1965 58 p refs
(Contract AF 30(602)-3478)
(RADC-TR-65-89; AD-617749)

Investigations of suitable heat sink material needed for CW operation resulted in the development of a BeO-loaded epoxy with a thermal conductivity of 1.6 BTU/Hr-Ft-°F. This appears compatible with the requirement as previously determined. The open-tube or dynamic technique was determined to be the most feasible for the epitaxial growth of CdS transducers. Theoretical and experimental investigations of the vacuum deposition of CdS resulted in films with resistivity values ranging from 300 ohm-cm to 7×10^6 ohm-cm. Good quality CdS crystals with high mobility and intermediate resistivity levels were obtained by annealing in a sulphur atmosphere. Investigation of the properties of zinc oxide crystals were initiated. Author

N65-30179# Los Alamos Scientific Lab., N. Mex.
ACTION OF A SHOCK WAVE ON A POROUS SOLID
J. Thouvenin 18 Dec. 1964 5 p refs Transl. into ENGLISH from Compt. Rend. (France), v. 258, 1 Apr. 1964 p 3461–3464
(LA-TR-64-34)

The propagation of a shock wave in a porous body is examined by considering the discontinuities and the periodicity of the associated phenomena in primary consideration of the granular character of the solid. The scheme proposed is in good agreement with experience. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-29319 Stevens Inst. of Tech., Hoboken, N. J.
THERMOPLASTIC SURFACE DEGRADATION-VAPORIZATION: A PIVOTAL BOUNDARY CONDITION FOR THEORIES OF SOLID PROPELLANT COMBUSTION PHENOMENA
Robert F. Mc Alevy, III *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 319–327 refs (See N65-29308 18-33)
(Contract Nonr-263(48))

Since thermoplastics are generally employed as the binder component of composite solid rocket propellants, a description of the response of the thermoplastic surface to the intense surface heating exposure encountered during combustion appears as a pivotally important boundary condition in the formulation of complete theoretical descriptions of solid propellant combustion processes. A testing technique is described which involves porous specimens fabricated by bonding together beads of the thermoplastic and passing through them a series of inert and chemically reactive test gases. The experiments were designed to illuminate the nature of the steady state regression process produced by an imposed constant level of surface heating. The measured surface regression rate of polymethacrylate was unaffected; however, that of polystyrene was accelerated by the presence of chlorine and nitrogen dioxide. Neither plastic exhibited an accelerated regression rate when oxygen or perchloryl fluoride were employed. E.E.B.

N65-29970# Naval Postgraduate School, Monterey, Calif.
LIQUID HYDROGEN—HIGH ENERGY ROCKET FUEL
Eugene A. Cernan (M.S. Thesis) 1963 92 p refs

Liquid hydrogen has been classed as a high energy fuel for rocket propulsion. A survey of the latest technical literature was made and the information compiled in a form which discusses the value of this fuel in propellant combinations. Thermodynamic performance, payload comparisons, advantages, disadvantages, problems, and relative merits of respective combinations and systems are presented. A discussion of rocket performance parameters is included as a basis for a more complete understanding of the information presented in the above-mentioned areas. Author

N65-30004# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW ADDITIVES TO FUELS AND LUBRICANTS
Ya. B. Chertkov 14 May 1965 10 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), v. 7, no. 3, 1962 p 64–66
(FTD-TT-65-62/1; AD-616312)

A review of Western literature dealing with fuel and lubricant additive developments is presented. Antioxidants for gasolines and other petroleum products, multifunctional additives, polymerization, and copolymer additives are among the topics considered; and the characteristics for a fuel-oil additive, are given. M.W.R.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-29301 Aerojet-General Corp., Sacramento, Calif.
COMBUSTION STABILITY DEVELOPMENT AT AEROJET-GENERAL
Robert J. Hefner *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 9–22 (See N65-29300 18-33)

Theoretical, applied research, and development work in combustion stability has been successful in providing analytical and development techniques which can be used to improve the stability characteristics of rocket engines with a reasonably high degree of confidence. Although the stability characteristics of any untested design cannot be predicted quantitatively, the capability to establish the proper directions to take in design modification to provide improved stability has been demonstrated. The stability histories of all of the injectors which have been developed to the point of consideration for final design on the Titan II, Titan III, Gemini, Apollo, and Transtage programs are outlined. All cases of high frequency instability associated with these injectors have occurred either during the start transient of the engine or as a result of a sharp perturbation during steady state. E.E.B.

N65-29302 Aerojet-General Corp., Sacramento, Calif. Combustion Dynamics Dept.
COMBUSTION STABILITY RESEARCH AT AEROJET-GENERAL
Frederick H. Reardon *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 25–37 (See N65-29300 18-33)

The combustion dynamics of the liquid oxygen–liquid hydrogen propellant combination at elevated chamber pressures was explored. The experimental hardware consisted of an 8-inch-diameter combustion chamber terminating in a short convergent exhaust nozzle. The chamber length was varied between 6 and 26 inches. The investigation was conducted at three chamber pressure levels of 1000, 1500, and 2500 psia. Nominal mixture ratio was 5 and the nominal thrust of the unit was 25 000 lb. High-frequency combustion instability was induced by tangentially directed pulse generators located near the injector. Three injectors were used: (1) a conventional multi-orifice type rated at 125-lb thrust per injection element; (2) a coaxial type delivering 1100 lb per element; and (3) a four-element pentad injector rated at 5000 lb per element. The sensitive time lag theory was used to correlate the experimental test results. Other experimentation is discussed to include the acoustic resonance properties of combustion chambers. E.E.B.

N65-29303 Rocketdyne, Canoga Park, Calif.
LIQUID PROPELLANT COMBUSTION INSTABILITY RESEARCH AT ROCKETDYNE
R. B. Lawhead *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 39–45 (See N65-29300 18-33)

Highlights of the combustion instability studies conducted in support of the Navaho, Atlas, Thor, Jupiter and H-1 engine development programs are reviewed briefly. The current studies in support of the F-1, J-2, and toroidal engine programs are discussed in detail. An analytical model of hydrogen–oxygen combustion, resonance of elliptical cavities, and extension of LOX–RP-1 steady-state combustion model to time dependent form, and two-dimensional thrust-chamber experiments testing dynamic stability are covered. E.E.B.

N65-29304 Princeton Univ., N. J.
NONLINEAR ASPECTS OF COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS
L. Crocco and D. T. Harrje *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 47–72 refs (See N65-29300 18-33)

Research activities associated with the high frequency modes of instability are briefly reviewed. The time-lag concept is discussed as a lumped parameter approach for the prediction as to where the unstable zones most likely exist. Also, the burning droplet model is considered as a useful concept in predicting the proper phase and amplitude relationship for the indication of coupling of pressure or velocity oscillations to the combustion process. In a droplet burning model, in order to verify the time-lag behavior it is necessary that enhanced burning due to unsteady effects peak in a specified range of frequencies. These frequency limits correspond to the periodic times perviously associated with lower and upper stability limits. Another mechanism for combustion instability for the longitudinal mode is the time and space variation in the generation of droplets. This mechanism is discussed and the results of pulsed-limits tests are given. E.E.B.

N65-29305 Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
INTERACTION OF PRESSURE DISTURBANCES WITH COMBUSTION REGIONS IN ROCKET MOTORS
S. N. B. Murthy, J. D. Hoffman, and G. M. Lehmann *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 73–92 refs (See N65-29300 18-33)
(Contract Nonr-1100(21); Grant AF AFOSR-62-360)

The interaction of a finite amplitude disturbance with a combustion region is discussed and a model chosen to represent the interaction of an acoustic wave with a combustion region is considered. The method of analysis discussed for the interaction is applicable to gaseous, liquid, or end-burning solid propellant rocket motors. The case of the end-burning solid propellant rocket motor is presented. The pulse is assumed to be propagating in the combustion chamber toward the burning surface of the solid propellant. The basic conservation equations of continuity, energy and momentum, the perfect gas equation of state, the assumed equations governing the chemical reaction rate, the pressure dependence of burning velocity, the effect of pressure perturbation on the concentration perturbation, and an expression for the flame zone width are given. The effect of the pressure perturbation is to cause a perturbation in each of the other flow parameters. E.E.B.

N65-29306 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORETICAL AND EXPERIMENTAL MODEL STUDIES OF COMBUSTION INSTABILITY
Richard J. Priem *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 93–96 (See N65-29300 18-33)

Theoretical calculations for the determination of stability limits are extended to include the atomization, vaporization, and chemical reaction processes. The extension also includes the influence of the quantity of propellant in the combustor ready to atomize, vaporize, or react. With these models it was found that with an unlimited quantity of propellant the chemical reaction process is the most sensitive to instability. With realistic values of propellant in the combustor the vaporization process is the most sensitive to instability. As the quantity of propellant in the combustor is further decreased the atomization process is most sensitive to instability. Decreasing the quantity of propellant always improves stability. Also, stability is very sensitive to the vortex velocity. A large vortex velocity will make almost any combustor unstable. Experiments conducted in a pancake and torus combustor confirmed the theoretical results. A vortex velocity will

produce instability in the pancake combustor depending on the operating conditions. Time histories of pressure, temperature, velocity, and propellant quantity in the combustor agree with calculated results. E.E.B.

N65-29307* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
20K H-O SCREECH WORK AT LEWIS
Harry E. Bloomer *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 99–110 (See N65-29300 18-33)

High frequency combustion instability in liquid propellant rocket engines is discussed. The investigation was made to determine similarity parameters for liquid propellant rocket engine design; to provide answers to present rocket engine development combustion problems; and to confirm instability theories. Most of the work was done on a scale of 20000 lb thrust level at a combustion chamber pressure of 300 psia with thrust variations to 5000 and 80000 lbs and chamber pressure variations to 100 and 1000 psia. Propellant combinations range from conventional rocket fuel and LOX to some of the exotic fuels, with major emphasis on the hydrogen–LOX and NTO-50-50 combinations. Results from initial phases of the program show the effects of propellant injection velocities and acoustic damping devices on temperature. Data from a bench test setup employed to investigate acoustic absorption devices are presented with the results of an analytical study for the design of a flightweight acoustic combustion chamber liner. E.E.B.

N65-29308 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMBUSTION INSTABILITY TECHNOLOGY AT THE MARSHALL SPACE FLIGHT CENTER
Robert J. Richmond *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 111–123 (See N65-29300 18-33)

Four programs are discussed for the investigation of combustion instability. These are: (1) liquid oxygen–RP-1 experimental injector investigation; (2) storable propellant combustion stability investigation; (3) F-1 gas generator injector study; and (4) combustion dynamics of liquid oxygen and RP-1. The performance and stability characteristics were determined for concentric tube, micro-orifice, and impinging jet rocket engine injectors using liquid oxygen and RP-1 propellants. The concentric tube injector showed unstable combustion and high performance at all mixture ratios above 1.5. Combustion was stable with lower performance for mixture ratios below 1.5. The micro-orifice injector and the impinging jet injector exhibited stable combustion with moderate performance. Thorough exploration of these concepts was prevented by structural limitations and injector face heating problems. E.E.B.

N65-29309 Princeton Univ., N. J.
LONGITUDINAL COMBUSTION INSTABILITY STUDIES USING A GASEOUS PROPELLANT ROCKET MOTOR
C.T. Bowman and I. Glassman *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 125–138 refs (See N65-29300 18-33)
(Contract AF 49(638)-1268)

The contribution of the gas phase to the overall instability process is considered. A rocket using pre-mixed gaseous propellants was chosen as the model eliminating those phenomena peculiar to solid or liquid propellant motors. Recent experiments are reviewed together with a reinterpretation of early experimental work. It was observed that the various modes of instability occur only for certain regions of operation, i.e., for certain values of chamber length, equivalence ratio, and mean chamber pressure. For a mean chamber pressure and equivalence ratio there exists a minimum chamber length for each mode of oscillation. The effect of mean chamber pressure on the mode of oscillation occurring in the chamber is shown. E.E.B.

N65-29310 Little (Arthur D.), Inc., Cambridge, Mass.
COAXIAL MIXING AND COMBUSTION INSTABILITY
Aubrey C. Tobey *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 139–152 (See N65-29300 18-33)

Flame piloting mechanisms and the effect of external disturbances on their characteristics are discussed. The most weakly driven mechanism near the injector face, that of recirculation, was of major concern. The primary measurements included local concentration and temperature and the variation of rocket chamber pressure with time. These variables were studied as functions of oxygen-to-fuel ratio, chamber length, injection configuration, inert gas injection rate, and position of inert gas injection relative to the injector face. The importance of events next to the injector face was demonstrated. The existence of a primary reaction zone bordered on one side by a fuel-rich zone and on the other side by an oxygen-rich zone was indicated. The concentration of a reactant in its respective zone increases with the distance from the primary reaction zone. On the fuel side an appreciable amount of fuel is noticeable with a dirth of oxygen. On the oxygen side the opposite is true. E.E.B.

N65-29311 Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
HIGH-FREQUENCY COMBUSTION INSTABILITY AND SCALING OF LIQUID PROPELLANT ROCKET MOTORS
Vito D. Agosta, Sanford S. Hammer, and William T. Peschke *In* APPL Proc. of the 1st ICRPG Combust. Instability Conf. Vol. 1 Jan. 1965 p 153–164 (See N65-29300 18-33)
(Contract AF 49(638)-1263)

The oscillatory behavior of the 500 lb thrust JP5-LOX rocket engine was investigated and the experimental results are reported. The thrust chamber is comprised of a two-inch internal diameter cylinder of variable length with a contraction ratio of 1.5 such that the nozzle entrance Mach number is about 0.45. The injector is either shower head or doublet. The doublets in the injectors impinge at either one distance from the injector face or at various locations down the chamber. A wave generator is attached to the injector plate. A very small mass of nitrogen gas is contained in the driver section which flows through a variable area channel and generates a continuous wave in the combustion chamber. The experimental results obtained from the determination of kinetic temperature by means of sound velocity measurements; wave analysis, and the effect of chamber length are also discussed. E.E.B.

N65-29312 Michigan Univ., Ann Arbor. Aircraft Propulsion Lab.
GASEOUS DETONATION STUDIES IN AN ANNULAR ROCKET MOTOR CHAMBER
J. A. Nicholls and R. E. Cullen *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 165–184 (See N65-29300 18-33)

The features pertinent to the feasibility of the rotating detonation wave rocket motor are discussed. The concept of such a motor was not ruled out from the study; however, experimental verification of the feasibility was not achieved. In the concept discussed the main problem which prevented the attainment of a cycling detonation wave involved the use of a nonpremixed system and the high turbulence levels of the

injector. The pertinence of the detonation motor study to combustion instability is also considered. The high turbulence levels that exist in conventional rocket motors are highly conducive to the onset of detonation. Also, there is a possibility that liquid drops can shatter, mix, and react rapidly enough to support a shock type structure. Further, the existence of high sound speed gases in a rocket motor is favorable to the stability of a detonation wave. Work relating to the possibility of obtaining a detonation wave wherein the fuel or oxidizer is in the form of liquid drops and the other is in the gas phase is also discussed. E.E.B.

N65-29313 Bell Aerosystems Co., Buffalo, N. Y.
EXPERIMENTAL TECHNIQUES FOR INVESTIGATING INSTABILITY IN LIQUID PROPELLANT ROCKET ENGINES
T. G. Rossmann *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 251–274 (See N65-29300 N65-29300 18-33)

The features and theoretical background of two experimental techniques developed to provide realistic information concerning the effect of injector design on the stability of operation of liquid propellant rocket engines and concerning phenomena and processes which are suspected of triggering low or high frequency instability are described. The first technique is the taking of high speed and high resolution spark photographs through windowed combustion chambers firing under actual operating conditions. This method gives single or multiple shadowgraphs of the liquid portions of the gas-liquid mixture in the chamber and provides a realistic insight into the behavior of liquid propellants after injection into a firing rocket chamber. The second technique is the method of forced oscillations. The method consists in producing controlled pressure oscillations of variable modulating frequency in the fuel or oxidizer manifold which excite forced pressure oscillations in the combustion chamber. Pressure oscillations in the fuel manifold and in the chamber are recorded by means of a cathode ray oscillograph. Such oscillographs are discussed. E.E.B.

N65-29315 Pratt and Whitney Aircraft. West Palm Beach, Fla. Florida Research and Development Center.
ACOUSTIC LINERS FOR ELIMINATING COMBUSTION INSTABILITY
George D. Lewis *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 251–274 (See N65-29300 18-33)
(Contract NAS8-11038)

Acoustic analysis and tests show that acoustic absorbing techniques are applicable to the problem of high frequency combustion instability in rocket engines. Acoustical absorbing liner analysis based on turbojet engine technology and modified for rocket engine conditions also indicates that absorbing liners can eliminate high frequency combustion instability in liquid rocket thrust chambers. Cooling analysis based on heat transfer theory and rocket engine experience indicates that adequate liner durability can be provided in ablative, regenerative, and mass-transfer cooled thrust chambers. Test data are summarized for the experimental program. E.E.B.

N65-29332 Stanford Research Inst., Menlo Park, Calif.
APPLICATION OF SCALING PRINCIPLES TO LARGE MOTOR DESIGN
L. A. Dickinson, E. L. Capener, and R. J. Kier *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 439–441 (See N65-29300 18-33)
(Contract AF 49(638)-1367)

The parameters of interest to the rocket motor designers are propellant burning rate, grain configuration, and overall motor geometry. These factors are discussed. The influence which burning rate has upon the initiation of finite amplitude axial wave instability was investigated using flow perturbations similar to those normally occurring in large rocket motors. It was found that axial instability could be initiated only in those composite propellants containing ammonium perchlorate and that the pressure at which instability could be induced correlated with burning rate. While the influence of the different types of grain perforation has not yet been revealed to be of great significance in relation to axial instability, the length-to-diameter relationship was shown to be important. For higher energy aluminized ammonium perchlorate propellants, stability is promoted by increases in propellant burning rate and motor size. Carefully controlled experiments relative to both propellant and motor size are needed to determine the relative importance of stabilizing processes. E.E.B.

N65-29333 Naval Ordnance Test Station, China Lake, Calif.
EFFECT OF GEOMETRICAL VARIABLES ON LOSSES IN MOTORS AS DETERMINED BY COLD-FLOW MODEL TESTING
H. B. Mathes *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 443–451 (See N65-29300 18-33)

The feasibility of using a cold-flow technique to provide acoustic loss measurements in model rocket motor chamber designs is demonstrated. The design of the test equipment provided for head-end excitation, gas flow down the model grain perforation, and a sonic nozzle at the downstream end of the model. Two methods were used to drive axial mode oscillations: (1) a variable frequency since wave generator; and (2) a pressure pulse created by firing a small black powder charge into the cavity. The results suggest that the dominant loss mechanism in axial-mode oscillations in end-vented rocket motor configurations is radiation through the nozzle. Also, the data support the contention that acoustic losses can change drastically during a motor firing due to changes in nozzle throat-to-grain port area ratio. E.E.B.

N65-29399*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ROCKET-MOTOR SPIN-TEST APPARATUS
Robert L. Swain, Melvin H. Lucy, and Peter H. Foss [1964] 25 p refs Presented at the 2d Ann. Meeting of the ICRPC Working Group on Static Testing, Redlands, Calif., 21–23 Oct. 1964 (NASA-TM-X-54778) CFSTI: HC $1.00/MF $0.50 CSCL 21H

The NASA-Langley Research Center has fabricated and extensively used a test apparatus capable of subjecting full-scale solid-rocket motors to the dynamic spin or roll environments normally encountered in flight use. This paper describes the design and performance characteristics of this apparatus which has been employed to test fire over 30 solid rockets ranging in weight from 100 to 2800 pounds, diameters to 30 inches, and lengths to 147 inches at roll rates from 100 to 900 rpm under both sea-level and simulated altitude conditions. The apparatus is driven by a timing belt assembly powered by an electrical synchronous motor having an electromagnetic coupling and brake. Changes in motor spin rate during firing are less than 2 percent. The rocket motor is supported fore and aft by roller bearings which do not sustain axial thrust but do permit longitudinal growth of the motor case during firing. Thrust is neutralized by a tapered roller bearing attached to the apparatus spin shaft. The rocket motor transmits its thrust to the spin through a spider assembly. No detectable thrust losses have been observed with this apparatus. Rocket-motor performance

is measured through up to 72 low-noise slip rings, and include pressure, temperature, and strain. Comparisons of data between firings of spinning and nonspinning motors have exhibited excellent agreement with no degradation due to the slip rings. Author

N65-29428*# National Aeronautics and Space Administration, Washington, D. C.
PROPULSION FOR LUNAR DESCENT AND ASCENT
A. O. Tischler and J. R. Flanagan [1964] 108 p refs Presented at the 15th Ann. Meeting of the Intern. Astronautical Congr., Warsaw, 12 Sep. 1964
(NASA-TM-X-51992) CFSTI: HC $4.00/MF $0.75 CSCL 21H

This paper examines several aspects of the propulsion problem for performing the lunar landing maneuver and for ascent from the moon's surface. The performance requirements of the propulsion equipment in terms of the several path alternatives are covered first; second, the arguments for the choice of the lunar rendezvous mode of approach, which has been selected as the method to be used for the manned landing mission are given; and third, a discussion is presented on the spacecraft propulsion equipment which is under development to perform lunar landing missions. Except for a general description of the overall manned mission, the paper is limited to an examination of the propulsion to be employed within the moon's sphere of activity; that is, where the moon's gravitational field is more important than the earth's. N.E.A.

N65-29468*# National Aeronautics and Space Administration, Washington, D. C.
SOLID ROCKETS: SEEKING A NEW PLATEAU. PART II: THE STATE-OF-THE-ART IN SOLID ROCKETS DESIGNED PRIMARILY FOR SPACE MISSIONS
Irving Silver and William Cohen 30 Jun. 1964 28 p Presented at the Natl. Meeting of the AIAA
(NASA-TM-X-51749) CFSTI: HC $2.00/MF $0.50 CSCL 21H

Advances in solid motor technology are reviewed, with emphasis on the developments which led to the design of motors with diameters of 120", 156", and 260". Areas of technology, which are considered as state-of-the-art, include concepts and developmental work on segmented motors; non-segmented, monolithic motors; motor cases; weld conditions; selection of materials and their fabrication; reworking capabilities of marage steels; nozzle concepts, and the feasibility of wrapped ablative nozzle designs; thrust vector control systems for solid rocket motors, such as liquid injection, jet tabs, and movable nozzles; processing, casting, and curing methodology for large, heavy motors; slurry insulation; and aft end and hypergolic ignition. Also discussed are preliminary investigations of failure warning systems; the re-use of motor cases, insulation systems, and nozzle components; hazard classifications; and cost effectiveness in relation to the merits of propulsion systems for large launch vehicles. M.G.J.

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N65-29636# Royal Aircraft Establishment, Farnborough (England).
THE DEVELOPMENT OF INJECTOR UNITS FOR JET-LIFT ENGINE SIMULATION ON LOW-SPEED-TUNNEL MODELS
M. N. Wood and J. B. W. Howard Feb. 1965 31 p refs
(RAE-TR-65020)

Small-scale injector units have been developed for providing the engine nacelles of V/STOL models, with both intake and exit flows. The primary energy supply was cold compressed air at pressure ratios up to 4:1. With the chosen injector arrangement, a stable and uniform exit velocity distribution was achieved, with a mean velocity of nearly 650 ft/sec, and almost 50% of the jet efflux drawn in through the intake. The requirements for engine simulation on model scale, and the capabilities and limitations of injector units for this application are discussed in an Appendix. Author

N65-29664# Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center.
RECOMMENDED APPLIED RESEARCH PROGRAMS FOR ADVANCED ROCKET PROPULSION SYSTEMS: NOZZLES, THRUST VECTOR CONTROL
6 Jan. 1964 29 p
(PWA-FR-875)

Applied research programs to provide the technology required for successful development of advanced propulsion systems are recommended. The majority of the programs are extensions of rocket propulsion technology that have evolved from current investigations. The advanced concepts considered are the following: plug cluster nozzle, radial flow nozzle, two-dimensional plug cluster nozzle, nozzle integration, noncircular exit nozzle, thrust vector control, and hot gas valve. The objective, advantages, status, and recommended effort are included for each of these items. E.E.B.

N65-29668# Aerojet-General Corp., Downey, Calif. Research Div.
LARGE SOLID-PROPELLANT BOOSTERS, EXPLOSIVE HAZARDS STUDY PROGRAM (PROJECT SOPHY) Monthly Progress Report, Mar. 1965
G. L. Roark 12 Apr. 1965 8 p
(Contract AF 04(611)-9945)
(Rept.-0866-01(10)MP)

Progress is reported on a program designed to study explosive hazard of large solid-propellant booster. This program consists of two major areas of technical inquiry: critical diameter and critical geometry. Matters concerning the program are discussed in the following sections: program funds status, milestone schedule, and problem areas. N.E.A.

N65-29822*# Tennessee Univ., Knoxville.
OPTIMUM CORRECTION OF THRUST TRANSIENT MEASUREMENTS
J. E. Irby and J. C. Hung Washington, NASA, Jul. 1965 23 p refs
(Grant NsG-351)
(NASA-CR-269) CFSTI: HC $1.00/MF $0.50 CSCL 21H

A study has been made of the methods of recovering the distorted thrust transient measurement. The distortion is caused mostly by the heavy mass of the measuring thrust stand. Two known methods are reviewed and discussed. The first method makes use of Fourier series approximation and numerical computation. This method, in general, requires the use of a digital computer. The second method employs a closed-loop network connected in cascade with the thrust stand output. The network is realized by analog computer simulation. A third method is proposed, which makes use of an open-loop network in cascade with the thrust stand output. The overall system is adjusted to achieve a maximally flat frequency response. Experimental results indicate that this method is the best. Author

N65-30088# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLID PROPELLANT ROCKET ENGINES
V. V. Pozhkov 23 Apr. 1965 102 p refs Transl. into ENGLISH of the book "Raketnyye Dvigateli Tverdogo Topliva" Moscow, Voyennoye Izd. Min. Oborony SSSR, 1963 p 1-96
(FTD-MT-64-185; AD-617664)

An elementary approach is taken in describing the working principles of solid propellant rocket engines. Basic characteristics of the engine and propellant are given, and a comparison is made with liquid propellants. Installation, arrangement, servicing, and arrangement of the engine on the rocket is shown. Means of magnitude adjustment, engine cut-off, adjustment of thrust direction, prospects for development, and suggested variations in the engines are also discussed. C.T.C.

N65-30153# Cincinnati Univ., Ohio.
PRESSURE RECOVERY MEASUREMENTS ACROSS A TWO-DIMENSIONAL HYPERSONIC INLET WITH VARIABLE GEOMETRY
Widen Tabakoff and James D. Mc Donel Wright-Patterson AFB, Ohio, ARL, May 1965 40 p refs
(Contract AF 33(616)-8453)
(ARL-65-93; AD-617620)

This report describes the experimental measurement of pressure recovery across a simulated combustion chamber duct of a two-dimensional hypersonic inlet with variable geometry. The model tested was a wedge type inlet which generated a single external shock wave. The program was conducted in the twenty-inch hypersonic wind tunnel located at the Aerospace Research Laboratories, Wright-Patterson Air Force Base, Ohio. Testing was at a nominal free stream Mach number of 14 and free stream Reynolds number of 0.721×10^6 per foot. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-29245# Joint Publications Research Service, Washington, D. C.
THE EFFECT OF COSMIC RADIO EMISSIONS ON RECEPTION OF INFORMATION ON BOARD ARTIFICIAL EARTH SATELLITES AND AT POINTS ON THE EARTH
Ye. M. Zhulina 26 Jul. 1965 7 p refs Transl. into ENGLISH from Geomagnetism i Aeronomiya (Moscow), v. 4, no. 6 p 1134–1136
(JPRS-31244; TT-65-31741) CFSTI: $1.00

An attempt is made in this article to evaluate the extent to which cosmic radio emissions interfere with the reception of signals from the satellite to the ground and signals from the ground to the satellite at a frequency of 20 Mc. Data on the audio reception of ground signals on board the satellite and on registration of the field strength of the satellite signal received on the ground, also records of the intensity of cosmic radio emissions in relative units made during the flights of the Vostok-3 and Vostok-4 space ships, at frequencies of 18 and 24.6 Mc are used in the evaluation. N.E.A.

N65-29248# California Univ., La Jolla. Dept. of Physics.
THE AVERAGE EFFECT OF THE ATMOSPHERE ON TRAPPED PROTONS
A. Hassitt 1 Jul. 1965 32 p refs
(UCSD-SP-65-4)

An efficient method of computing the average atmosphere, encountered by particles trapped in the earth's magnetic field is described. An average height is defined. It is shown that this height is a slowly varying function of L (the magnetic shell parameter), B_m (the magnetic field at the mirror point) and μ (the inverse of the scale height). Coefficients for low order polynomial fits to the average height are given. Some models of the atmosphere are compared with measurements of trapped proton fluxes. Author

N65-29406*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STUDIES OF SOLAR PROTONS WITH EXPLORERS XII AND XIV
D. A. Bryant, T. L. Cline, U. D. Desai, and F. B. Mc Donald Jul. 1964 51 p refs Submitted for Publication
(NASA-TM-X-51969; X-611-64-217) CFSTI: HC $3.00/MF $0.50 CSCL 20H

Four solar proton events observed by Explorers XII and XIV in 1961 and 1962 are discussed. These events are directly associated with solar activity and, in three cases, are followed either by secondary events delayed about 2 days or by recurrent events on succeeding solar rotations. It is shown that the rate of propagation of solar protons in some of these primary events is linearly dependent on particle velocity and that this dependence makes it possible to separate the source characteristics from the propagation effects. In each event which shows this velocity dependence the propagation curves of all observed energies agree and reach maximum intensity at a time much greater than the rectilinear travel time. These results lead immediately to the conclusions that propagation involves an important degree of scattering and that the degree of scattering is independent of energy over the observed range of 1.4 to 500 mev. Author

N65-29415*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RADIATION ENVIRONMENT NEAR THE EARTH
Wilmot N. Hess [1964] 29 p Submitted for Publication
(NASA-TM-X-54730) CFSTI: HC $2.00/MF $0.50 CSCL 20H

In considering the radiation environment of the earth, particles found close to the earth as well as the environment that satellites and space probes have encountered or may encounter in the future should be studied. This environment includes: (1) cosmic rays; (2) solar wind; (3) solar energetic protons; (4) the Van Allen radiation belt; (5) auroral particles; (6) shock wave particles; (7) artificial radiation belts; and (8) planetary radiation belts. This paper presents a brief survey of some of the engineering problems associated with the particle radiation. N.E.A.

N65-29419*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
CORPUSCULAR STREAMS RELATED TO SOLAR M-REGIONS
Tatsuzo Obayashi (Kyoto Univ.) [1964] 29 p refs Presented at the Inter-Union Comm. on Solar Terrest. Relations, Hamburg, 24 Aug. 1964
(NASA-TM-X-51964) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Recent studies on 27-day recurrence geomagnetic disturbances and their associated phenomena during the decline phase of the present sunspot cycle are summarized. An identification of M-region with solar phenomena has been made by evaluating the velocity of solar winds. Discussions are given on various existing hypotheses of corpuscular streams producing M-disturbances. Author

N65-29436*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE UV LINES OF FEXIV IN THE SOLAR CORONA

R. Stockhausen Jul. 1964 14 p refs
(NASA-TM-X-54739; X-610-64-202) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Knowledge of the structure of the solar corona can be increased by observations of the many emission lines in the far ultraviolet. The difficulty in the identification of these lines because of the lack of knowledge of many of the atomic parameters relevant to these lines and the calculation of energy levels and oscillator strengths for the Fe XIV for the prediction of lines strengths and wave lengths for the lines of this ion are discussed. Also, the relationship of collision cross-sections of the optically permitted lines and oscillator strengths are considered. The production rates for ultraviolet lines due to transitions ending in the two levels of the ground term are given for two temperatures and three values of the exchange cross-section. A mechanism for line strength re-distribution is also considered. E.E.B.

N65-29448*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ASYMPTOTIC CONES OF ACCEPTANCE OF COSMIC RAY NEUTRON MONITORS IN A GEOMAGNETIC FIELD DISTORTED BY THE SOLAR WIND
H. Razdan and Audrey L. Summers [1965] 17 p refs Submitted for Publication CFSTI: HC $1.00/MF $0.50 CSCL 20H
(NASA-TM-X-51943)

Various studies of spatial anisotropies in cosmic radiation in interplanetary space are reviewed. To determine variations in the electromagnetic state of the interplanetary medium, cosmic ray trajectories were calculated numerically on an IBM 7094 computer, and the asymptotic cones for a distorted geomagnetic field were compared with those for a dipole field. The trajectory behavior near the geomagnetic cutoff for a dipole and the distorted geomagnetic field were also compared. Equations were derived for the magnetic field configuration in which the earth's field is completely confined in an approximately ellipsoidal cavity extending 7-1/2 earth radii in the solar direction and 24 earth radii in the night direction. An assumption that the boundary of the deformed magnetosphere is an ellipsoid of revolution was made, and the boundary equation for the ellipsoidal magnetosphere was derived. The asymptotic directions of cosmic ray particles outside the magnetosphere and arriving at a particular geomagnetic latitude were calculated by considering an equivalent problem of the motion of negative particles of the same rigidities moving in the reverse direction. Further, a steep cosmic ray rigidity spectrum corresponding to a minimum solar active period was used for giving proper weighting to asymptotic directions of various particle rigidities. W.M.R.

N65-29460*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIME CORRELATION OF EXTREME ULTRAVIOLET RADIATION AND THERMOSPHERIC TEMPERATURE
R. E. Bourdeau, S. Chandra, and W. M. Neupert Jun. 1964 15 p refs *Its* Ionospheric Phys. Preprint Ser. Submitted for Publication
(NASA-TM-X-51891; X-615-64-211) CFSTI: HC $1.00/MF $0.50 CSCL 04A

Thermospheric temperatures deduced from satellite drag observations are compared with the intensity of extreme ultraviolet radiation measured on the first Orbiting Solar Observatory (OSO-1). The comparison leads to a conclusion that, for the two complete solar rotation periods during which the EUV data are available, the 27-day periodic variation in upper atmospheric density was due to corresponding changes principally of ultraviolet rather than corpuscular radiation. Author

N65-29463*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC EFFECTS OF THE QUIET TIME PROTON BELT
R. A. Hoffman and P. A. Bracken Jun. 1964 53 p refs Submitted for Publication
(NASA-TM-X-51897; X-611-64-186) CFSTI: HC $3.00/MF $0.50 CSCL 20H

An analysis of the magnetic effects of the quiet time proton belt has been performed with data obtained from a proton detector aboard Explorer XII. From the measured energy spectra, intensities, and pitch angle distributions of the protons with energies above 100 kev, the current density on a magnetic meridian plane was calculated using the theory of Akasofu and Chapman, modified to eliminate several simplifying assumptions. The algebraic sum of all the currents was 0.59 million amperes, and the magnetic moment of the current loop was $0.029 M_E$. From the electric current distribution the magnetic perturbations on the meridian plane were obtained. At the magnetic equator on the earth's surface the proton belt produced a 9_γ decrease in the field in comparison with the 38_γ decrease reported by Akasofu, Cain and Chapman based on some preliminary data from the same detector. The maximum perturbation appeared at L = 3.6 on the magnetic equator, where the field attained a value of -23_γ. Author

N65-29467* Pennsylvania State Univ., University Park. Dept. of Aeronautical Engineering.
WEAK SHOCK WAVES IN THE IONOSPHERE
D. P. Holt 23 Jul. 1964 9 p refs Submitted for Publication
(Grant NsG-134-61; Contract DA-ARO-31-124-6537)
(NASA-CR-58326) CFSTI: HC $1.00/MF $0.50 CSCL 04A

It is shown that in the D-region of the ionosphere, the shock formed by the nose of a sounding rocket introduces serious errors in measurement of the ionic composition of the region. A simple model of the chemistry of the ionosphere is developed, which correctly predicts the equilibrium composition of the D-region as estimated by Nicolet and Aikin. Using this model, we made a calculation of the chemical structure of a weak shock in the ionosphere. The result is compared with an equilibrium calculation. The effects of impurities are discussed. Author

N65-29470*# Pennsylvania State Univ., University Park.
[DIFFUSION AND DRIFT VELOCITIES IN NIGHTTIME F REGION AND ION DENSITY IN D-REGION ROCKET PROGRAM] Semi-Annual Status Report, 1 Sep. 1963-29 Feb. 1964
[1964] 10 p
(Grant NsG-134-61)
(NASA-CR-58437) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Various theories on the F region are under study to obtain solutions to problems such as accurate values for drift velocity, diffusion coefficient, and recombination coefficient; diurnal behavior in comparison with nocturnal equilibrium analyses; the height of the maximum electron density; basic physical constants of the production, recombination and transport processes; and electron density height profiles. Methods were also developed to calculate the diffusion and the drift velocities in the nighttime F region. The ion neutral particle collision frequency was determined as a function of height and, if a neutral atmospheric model was available, enabled values for the diffusion coefficient to be obtained. Results of this analysis showed a value of the normalized diffusion coefficient

$$\frac{Dn[O]}{T^{1/2}} = .5 \pm .2\ cm^{-1}\ sec^{-1}$$

A program was also initiated to design instruments of ion

density (positive and negative) in the D-region of the ionosphere. It was decided that the most basic problem associated with rocketborne D-region experiments involves choosing the proper geometry to minimize aerodynamic effects upon measurements. R.W.H.

N65-29496*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
THE VAN ALLEN RADIATION BELT
Thomas A. Farley 12 May 1964 33 p refs Submitted for Publication
(Grant NsG-249)
(NASA-CR-58983) CFSTI: HC $2.00/MF $0.50 CSCL 20H

The discovery of the Van Allen radiation belt and phenomena concerning the energetic protons and electrons trapped in the geomagnetic field are reviewed. Also considered are approximations for charged particle motion in the geomagnetic field, and the gyroradii and periods of the motions of particles in the guiding center approximation are tabulated. An explanation of the energy spectrum and the distribution of trapped electrons and protons is given, and sinks and sources of trapped particles are also discussed. C.T.C.

N65-29510 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ADVANCES IN PARTICLES AND FIELD RESEARCH IN THE SATELLITE ERA
W. Hess, G. Mead, and M. P. Nakada *In* NAS-NRC U. S. Space Sci. Program 1965 60 p refs (See N65-29509 18-30)

Solar wind and its effect on the earth, the magnetosphere, transition zone and shock waves, radiation belts, magnetic field of the earth, solar energetic particles and ground effects, cosmic rays, and neutrons are discussed in light of recent research findings dealing with particles and plasma. Findings related to the discovery of radiation belts as well as various types of belts, and the aurora are reviewed. A table presents data on important satellites and space probes in particles and field research, and a comprehensive bibliography is appended. M.W.R.

N65-29514*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
COMPILATION OF SCIENTIFIC OBJECTIVE PORTIONS OF AMES RESEARCH CENTER STUDY CONTRACTS ON A SOLAR PROBE AND A SHORT REPORT ON "PARTICLE AND FIELDS EXPERIMENTS FOR A SOLAR PROBE"
[1963] 161 p refs
(NASA-TM-X-56676) CFSTI: HC $5.00/MF $1.00 CSCL 20H

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1. PARTICLE AND FIELDS EXPERIMENTS FOR A SOLAR PROBE E. N. Parker 5 p (See N65-29515 18-29)
2. (A SOLAR PROBE VEHICLE) 59 p refs (See N65-29516 18-29)
3. SCIENTIFIC OBJECTIVES (OF THE SOLAR PROBE), VOLUME II J. P. Martin 34 p (See N65-29517 18-29)
4. SCIENTIFIC OBJECTIVES (OF THE SOLAR PROBE) 21 p refs (See N65-29518 18-29)
5. REPORT OF SUGGESTED EXPERIMENTS ORIENTED PRINCIPALLY TO SOLAR PHYSICS FOR A CLOSE-IN SOLAR PROBE R. G. Athay and L. L. House 40 p refs (See N65-29519 18-29)

N65-29515* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARTICLE AND FIELDS EXPERIMENTS FOR A SOLAR PROBE
E. N. Parker *In its* Comp. of Sci. Objective Portions of Ames Res. Center Study Contracts [1963] 5 p (See N65-29514 18-29) CFSTI: HC $5.00/MF $1.00

Questions involving the propagation mechanism of solar energy and the structure of the particle fields near earth are considered. The role of a solar probe in studying the structure of the solar corona, the origin of its energy supply, the development of the blast waves that produce magnetic activity, and the origin and development of turbulence in the interplanetary field fluctuations is discussed. L.S.

N65-29516* General Electric Co., Philadelphia, Pa. Missile and Space Div.
[A SOLAR PROBE VEHICLE]
In NASA. Ames Res. Center Comp. of Sci. Objective Portions of Ames Res. Center Study Contracts [1963] 59 p refs (See N65-29514 18-29) CFSTI: HC $5.00/MF $1.00

A solar probe vehicle, and its mission and experimental package is described. The vehicle is designed to range over heliocentric distances between 1.0 and 1/3 AU with a corresponding orbital period of about six months, and to provide scientific measurements contributing to understanding the flow of the solar wind (particularly near the sun), to study the dimensions of large plasma clouds ejected from active regions and paths at widely different heliocentric longitudes to the sun, to study the structure of the interplanetary field, to search for evidence of possible solar magnetic field line detachments, to obtain data on solar flare particles and events from observations on the back side of the sun, to study electron distribution over long paths through the inner solar system via radio phase shifts, to obtain coronal electron densities as a function of depth and time, to search for new micrometeoroid showers as an aid to theories of their origins, and to study the micrometeoroid size distribution as a function of heliocentric distance to learn more about energy loss mechanisms. Diagrams of optical and TV systems of the solar probe are included. L.S.

N65-29517* Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
SCIENTIFIC OBJECTIVES [OF THE SOLAR PROBE], VOLUME II
Joseph P. Martin *In* NASA. Ames Res. Center Comp. of Sci. Objective Portions of Ames Res. Center Study Contracts [1963] 34 p (See N65-29514 18-29) CFSTI: HC $5.00/MF $1.00 (ER-13110-II)

Solar atmospheric theories are surveyed, and experiments for a solar probe mission are discussed. The experiments are concerned with measuring solar wind properties, the magnetic fields, and the energetic charged particles of solar and galactic origin. Special requirements for the experiments are discussed, such as magnetic cleanliness in the vehicle and interference to the particle detectors by a radioisotope power supply. It is seen that a plasma probe and charged particle detector gain in usefulness by being mounted on a rotating platform, but that the magnetometer and neutron detector should be on a 25-ft boom. A bare minimum payload is presented to illustrate what instruments are absolutely essential to making the solar probe worthwhile. A lightweight payload of 30 lbs is suggested. Also discussed is a VHF transmission experiment to obtain electron density information on the outer corona by observing the dispersive doppler shift of a VHF signal transmitted from earth to the spacecraft. It is concluded that a solar approach in the vicinity of 0.2 to 0.4 AU should satisfy most of the scientific objectives proposed. L.S.

N65-29518* Philco Corp., Palo Alto, Calif. Western Development Labs.
SCIENTIFIC OBJECTIVES [OF THE SOLAR PROBE]

In NASA. Ames Res. Center Comp. of Sci. Objective Portions of Ames. Res. Center Study Contracts [1963] 21 p refs (See N65-29514 18-29) CFSTI: HC $5.00/MF $1.00 (WDL-TR-2133)

General objectives for a solar probe series, identification of sets of experiments that best fulfill the objectives, the type of measurements required, and the instrumentation needed to accomplish the measurements; and selection of the proper trajectory for the probes are discussed and summarized in a table. Among the experiments considered are those involving radio signal transmission through the interplanetary medium, solar cosmic emission and bistatic radar experiments. A chart indicating the various favorable regions for electromagnetic radiation and propagation measurements is also presented. L.S.

N65-29519* High Altitude Observatory, Boulder, Colo.
REPORT OF SUGGESTED EXPERIMENTS ORIENTED PRINCIPALLY TO SOLAR PHYSICS FOR A CLOSE-IN SOLAR PROBE
R. Grant Athay and Lewis L. House *In* NASA. Ames Res. Center Comp. of Sci. Objective Portions of Ames Res. Center Study Contracts [1963] 40 p refs (See N65-29514 18-29) CFSTI: HC $5.00/MF $1.00

A series of experiments that could be implemented by means of a solar probe are discussed for their merits. The suggested experiments are listed along with the maximum sun-probe distance, the required pointing and direction of the probe, and the scan (if any). Among the suggested measurements to be made are those involving absorption and emission spectral data, and solar neutron, coronal, ultraviolet, X-ray, radio, plasma oscillation, field, particle, and gravitational data. L.S.

N65-29556* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESULTS FROM THE IMP I RETARDING POTENTIAL ANALYZER
G. P. Serbu *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 77–86 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

Some preliminary experimental results obtained with a planar geometry retarding potential analyzer flown on the IMP I satellite are presented. The plasma energy spectrum for both ions and electrons was measured in the range from 0 to 100 ev. Charged particle density measurements have been obtained for the complete range from 1000 km to 30 R_E. The results show a sharp decrease of about an order of magnitude in charged particle density at about 4.5 R_E—similar to the decrease deduced from whistler observations. The electrons exhibited thermal energies for geocentric distances less than 4.5 R_E; the average electron energy then increased gradually to values above 100 ev at about 8 R_E. The observed satellite potential was less than 1 v positive. Author

N65-29558* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORETICAL STUDIES OF PROTONS IN THE OUTER RADIATION BELT
M. P. Nakada, J. W. Dungey (Imperial Coll., London), and W. N. Hess *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 143–147 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

The variations in the energy spectra with pitch angle and L of the relatively stable 0.1 to 5 Mev protons in the outer radiation belt have been found to be in good agreement with the results of a model that permits rapid motion of the protons in L space. In this model, the protons violate the third adiabatic invariants. Changes in fluxes with L are not consistent with Liouville's theorem. Both the departure from Liouville's theorem and variations in energy spectra seem to indicate that the source of these protons is at large L. Author

N65-29559* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR CYCLE CHANGES IN INNER ZONE PROTONS
Robert C. Blanchard and Wilmot N. Hess *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 149–161 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

Time dependent calculations of the inner Van Allen belt proton population show that large changes of the population, up to a factor of 50, will take place during the solar cycle. The effect is most pronounced for the region of B-L space corresponding to minumum altitudes of 300–700 km. Because different energy protons respond to the changing solar cycle at different rates the proton energy spectra will change with time also. Author

N65-29560* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR X-RAY BURSTS IN THE 20 TO 100 KEV RANGE OBSERVED BY OSO-I
Kenneth J. Frost *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 163–168 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

During the months of March, April, and May, 1962, instrumentation aboard OSO-I observed five solar-flare associated high-energy x-ray bursts. The instrumentation which observed these bursts was designed to monitor the solar x-ray flux in the 20 to 100 kev energy range. The beginning and the end of each event was observed. All events were accompanied by radio bursts of impulsive character in the microwave range. Plots of flux density versus wavelength for the associated microwave outbursts yield curves similar to the curves which Kundu found to be associated with previously observed x-ray bursts. Sudden ionospheric disturbances also accompany each high energy x-ray burst. Consideration of the radio data, the short duration of the x-ray bursts, and the energy of the bursts lead to the conclusion that we are observing a process which is located in the chromosphere and is non-thermal in character. Author

N65-29561* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DETECTION OF INTERPLANETARY 3- TO 12-MEV ELECTRONS
T. L. Cline, G. H. Ludwig, and F. B. Mc Donald *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 169–173 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

Direct observations have been made with a scintillator telescope of interplanetary electrons in the 3- to 12-Mev range with the IMP-I satellite (Explorer XVIII). Electron data, reported only when the satellite was beyond 125 000 kilometers, were free from effects due to trapped radiation. When a table was constructed from data taken at apogee to show intensity versus measured energy loss and total energy, a distinct versus measured energy loss and total energy, a distinct counting rate component of minimum ionizing energy loss and low apparent energy was seen. Analysis indicated three different particle groups, two of which were thought to be secondary radiations consisting of either gamma rays or spurious cosmic rays. When these secondary affects were eliminated, the resulting corrected spectra suggested that the electrons seen daily may have the same origin as the extra ones seen on days of increased electron flux. The existence of an interplanetary flux of electrons lower in energy presents the possibility of cosmic origin of electrons, despite many arguments supporting galactic origin. M.W.R.

N65-29562* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENT OF LOW ENERGY PRIMARY COSMIC RAY PROTONS ON IMP I SATELLITE
F. B. Mc Donald and G. H. Ludwig *In its* Contrib. to the COSPAR Meeting Jul. 1965 p 175–179 refs (See N65-29550 18-13) CFSTI: HC $5.00/MF $1.00

Measurements of the intensity and energy spectra of cosmic ray protons in the 15 to 75 MeV range were made with a three element energy versus energy-loss telescope aboard the IMP-I satellite (Explorer XVIII). Proton intensity was observed to be 19 protons/m^2-sec-ster or approximately 1% of total primary cosmic ray intensity, and a steeply falling energy spectrum toward lower energies was also observed. The clean resolution of the proton distribution at all energies is reported as striking. To search for long term variations, the data were divided into two time intervals; except at the lowest energy point, these data are consistent with a change of less than 10% in the proton flux. The flux of the deuterium could not be resolved from the background and an upper limit of 8% of the proton flux over the corresponding energy level was set. Preliminary data indicate that the production of the observed steep proton energy spectrum is not unexpected, and that further observations of solar minimum coupled with low energy measurements of multiply charged primaries will permit more accurate determinations of source spectra and the solar modulation mechanism. M.W.R.

N65-29576# Boeing Co., Seattle, Wash.
A COMPUTER PROGRAM INCORPORATING THE WHITAKER THREAT MODEL INTO THE SPACE RADIATION ENVIRONMENT AND SHIELDING COMPUTER PROGRAM Technical Report, Aug. 1964–Mar. 1965
J. A. Barton, W. R. Doherty, and P. G. Hahn Kirtland AFB, N. Mex., AF Weapons Lab., May 1965 72 p refs
(Contract AF 29(601)-6612)
(AFWL-TR-65-10; AD-616106)

The objective of this program was to incorporate the Whitaker threat model computer code into the space radiation codes. To accomplish this objective, the following tasks were performed: (1) The injection model was modified to treat the effect of extended sources at early times; (2) The emission rate spectrum was extrapolated down to 0.5 Mev and the results incorporated; (3) The spectrum of the electrons impinging on the vehicle was decomposed into energy bins suitable for dose rate and dose calculations. A description of the methods used in these tasks and the details of the resulting computer code are given. Suggestions for significantly extending the model and for improving methods for their incorporation are also presented. Author

N65-29667# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR OCTOBER 1964 FROM SALISBURY, SOUTH AUSTRALIA
Dec. 1964 26 p
(WRE-CPD-1964/10(S))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Salisbury for October 1964. Author

N65-29671# Stanford Research Inst., Menlo Park, Calif.
THE USE OF ION PROBES IN RE-ENTRY PHYSICS
H. R. Bredfeldt, W. E. Scharfman, H. Guthart, and T. Morita May 1965 83 p refs
(Contract SD-103; ARPA Order 281-62)
(TR-26; AD-464807)

Classical (Langmuir) probe theory is reviewed and the conditions under which it is applicable to the re-entry physics problem identified. Some later developments in probe theory, which account for flow velocity in the free-molecular case, are presented. Measurements of current densities have been made with ion probes mounted flush in the walls of a pressure-driven shock tube; the results are interpreted using a one-dimensional, collision-dominated probe theory, allowing for the spatial nonuniformities in ion density. Correlation of the probe theory with a zero-order gas dynamic boundary layer theory is shown to lead to theoretical current estimates in fair agreement with the experimentally observed values. Some shock ionization precursor results in air are also presented. Finally, the results of some calibrations on probes that were flown on the RVIP and LORV programs are presented. Author

N65-29741*# National Aeronautics and Space Administration, Washington, D. C.
PROTECTION FROM PRIMARY COSMIC RADIATION AND PROTONS OF THE EARTH'S INNER RADIATION BELT [ZASHCHITA OT PERVICHNOGO KOSMICHESKOGO IZLUCHENIYA I PROTONOV VNUTRENNEGO RADIATSIONNOGO POYASA ZEMLI]
V. Ye. Dudkin, Ye. Ye. Kovalev, L. N. Smirennyy, and M. A. Sychkov Apr. 1965 12 p refs Transl. into ENGLISH from Vopr. Dozimetr. Zashchit. ot Izluch. (Moscow), 1964 p 174-184
(NASA-TT-F-9517) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Data on the proton and electron concentration in the Earth's inner radiation belt, collected by the Agena and Explorer satellites, are used for establishing the proton spectrum of the belt. The electron flux at the center of the belt is given as 10^5 protons/cm^2-sec. A mean proton spectrum is used for calculating the required shielding of space capsules and astronauts exposed in space. Mean tissue doses for astronauts, as a criterion for radiation hazard, are calculated and tabulated for several arbitrary orbits. Safe altitudes of orbits and orbital inclination angles are given, taking secondary radiation in the shielding and in the astronaut's body by the primary cosmic radiation into consideration. Author

N65-29775*# TRW Systems, Redondo Beach, Calif. Quantum Physics Lab.
THEORETICAL STUDY OF THE COUPLING BETWEEN THE SOLAR WIND AND THE EXOSPHERE Final Report, 23 Jun. 1964–22 Jun. 1965
F. L. Scarf 12 Jul. 1965 69 p refs *Its* Rept.-8
(Contract NASw-698)
(NASA-CR-64057; STL-8494-6008-RU-000) CFSTI: HC $3.00/MF $0.75 CSCL 20H

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1. EFFECTS OF SOLAR WIND COMPOSITION ON THE THRESHOLD FOR PLASMA INSTABILITY IN THE TRANSITION REGION R. W. Fredricks and F. L. Scarf 35 p refs (See N65-29776 18-29)

2. PRODUCTION OF SUPERTHERMAL ELECTRONS BY ELECTROSTATIC PLASMA OSCILLATIONS R. W. Fredricks 27 p refs (See N65-2977 18-29)

N65-29776* TRW Systems, Redondo Beach, Calif.
EFFECTS OF SOLAR WIND COMPOSITION ON THE THRESHOLD FOR PLASMA INSTABILITY IN THE TRANSITION REGION
R. W. Fredericks and F. L. Scarf *In its* Theoret. Study of the Coupling between the Solar Wind and the Exosphere 12 Jul. 1965 35 p refs (See N65-29775 18-29) CFSTI: HC $3.00/MF $0.75

The effect of a small concentration of solar wind alpha particles on the conditions for drift instability in the transition region is investigated. It is shown that for alpha particle concentrations less than about 20 percent, the proton-electron threshold curve is sufficiently accurate, for the range of relative electron-proton-alpha particle drift speeds of interest. Recent transition region plasma measurements are interpreted in terms of the conditions for marginal stability with respect to electrostatic plasma oscillations. Author

N65-29777* TRW Systems, Redondo Beach, Calif.
PRODUCTION OF SUPERTHERMAL ELECTRONS BY ELECTROSTATIC PLASMA OSCILLATIONS
R. W. Fredricks *In its* Theoret. Study of the Coupling Between the Solar Wind and the Exosphere 12 Jul. 1965 27 p refs (See N65-29775 18-29) CFSTI: HC $3.00/MF $0.75

The beam-plasma interaction which has been proposed by Stix is examined both by approximate analysis and by integration of the nonlinear equations of motion which describe the interaction of an individual electron with a monochromatic large amplitude electrostatic plasma wave. The quasi-stochastic model of the large amplitude plasma waves, introduced by Stix, has been used in the calculations by programming a random phase function into the argument of the periodic plasma wave function. It is found that electrons are subject to a quasi-cyclotron acceleration which limits generally at a higher energy in the stochastic case than the limit found in the non-stochastic case (a phase-coherent plasma wave). This behavior is interpreted in terms of a limit cycle phenomenon, and the stochastic phase shift appears to push electrons across these limit cycles. It is also found that favored groups of electrons in a 2eV plasma excited by a 5keV beam in a 2000 gauss field can achieve energies in the range 85 to 170 keV in less than a nanosecond by a single acceleration occurring in one plasma wave coherence length L_z as defined by Stix. Author

N65-29808*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REVIEW OF GALACTIC AND SOLAR COSMIC RAYS
F. B. Mc Donald Mar. 1965 37 p refs
(NASA-TM-X-55245; X-611-65-94) CFSTI: HC $2.00/MF $0.50 CSCL 20H

A summary of some of the salient features of both galactic and solar cosmic rays is presented. Charge, energy, and spatial distribution of galactic cosmic rays; charge, frequency, and size of solar cosmic rays; the energy spectrum of solar cosmic rays; and propagation characteristics are discussed. R.N.A.

N65-29816*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CALCULATIONS OF LONGITUDE DEPENDENCE OF GEOMAGNETICALLY TRAPPED ELECTRON FLUXES. PART I: THE GENERAL FOKKER-PLANCK EQUATION FOR ELECTRON DIFFUSION
J. G. Roederer and J. A. Welch (AFSC, Andrews AFB) Apr. 1965 38 p refs Presented at COSPAR Buenos Aires, 13-19 May 1965
(NASA-TM-X-55250; X-640-65-149) CFSTI: HC $2.00/MF $0.50 CSCL 08N

A general Fokker-Planck equation is deduced, which describes the distribution of geomagnetically trapped electrons as a function of longitude, time, energy and mirror point field intensity. A special variable for the longitudinal position of a particle is introduced. It is found that the usual procedure of averaging over longitude in order to obtain a longitude-independent equation, is not valid for the description of electrons mirroring at low altitudes. In that case, the longitude dependence cannot be averaged out, and a four-dimensional equation must be used. The coefficients representing longitudinal drift, ionization loss and multiple, screened Coulomb scattering in the general Fokker-Planck equation are deduced. Author

N65-29847*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LATITUDINAL VARIATIONS OF ELECTRON TEMPERATURE AND CONCENTRATION FROM SATELLITE PROBES
L. H. Brace and B. M. Reddy May 1965 32 p refs Presented at the COSPAR 6th Intern. Space Sci. Symp., Buenos Aires, 13-19 May 1965
(NASA-TM-X-55262; X-651-65-190) CFSTI: HC $2.00/MF $0.50 CSCL 04A

Measurements of electron temperature (T_e) and concentration (N_e) have been made by the use of cylindrical electrostatic probes on the Explorerer XXII satellite, which was launched in October 1964. The measurements reveal a remarkable symmetry about the magnetic equator which suggests a strong degree of geomagnetic control. The mean ion mass, inferred from the ion current measurements, suggest that H^+ is the dominant ion at the equator and O^+ predominates above 40° magnetic latitude. Small scale fluctuations of the electron currents to the probes during some of the polar region measurements reveal fine irregularities in N_e along the satellite path. These irregularities occur primarily in the midnight to sunrise period and have horizontal dimensions of only a few hundred meters and amplitudes of up to 30%. Nearly all occur poleward of the auroral zone. Author

N65-29957*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AURORAL PARTICLES FROM THE GEOMAGNETIC TAIL. I
T. W. Speiser Apr. 1965 21 p refs
(NASA-TM-X-55253; X-640-65-165) CFSTI: HC $1.00/MF $0.50 CSCL 20H

An analytical study is presented of particle trajectories about a neutral sheet. A simple model was constructed where magnetic field varied linearly, reversing across the neutral sheet, and the electric field was everywhere homogeneous, perpendicular to the magnetic field and parallel to the neutral sheet. The important results in this case are that either protons or electrons never come out of the neutral sheet and gain an unlimited amount of energy. Another model was constructed by adding a small component of the magnetic field perpendicular to the neutral sheet. Such a component could be furnished by the earth's dipole field in the tail. This component not only serves to bring the particles out of the neutral sheet, but turns both electrons and protons 90° from the accelerating field in toward the earth. Also, all particles that are injected into the neutral sheet far enough from the earth emerge with small pitch angles to the magnetic lines of force. Particles injected at about 50 R_e (earth-radii) emerge in a cone about 1/2° about a line of force, the angle of the cone varying inversely as the cube of the distance from the earth. E.E.B.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-29168# Joint Publications Research Service, Washington, D. C.
NEWS ITEMS ON ROCKETS AND AEROSPACE TECHNOLOGY
G. Gel'perin et al 26 Jul. 1965 15 p Transl. into ENGLISH from Tekhn. Molodezhi (Moscow), no. 9, 1964 p 17–21
(JPRS-31236; TT-65-31733) CFSTI: $1.00

The exploits of Soviet pilots and cosmonauts are narrated, a capsule history of man's conquest of space is presented, and the creative conceptions of a Soviet scientist are summarized. Also included is a brief outline of a method for recovering the first few rocket stages. Said to be an American development, the method employs parachutes to retard the rocket's speed, and the use of helicopters to hook the cable of the auxiliary parachute. M.G.J.

N65-29175# George Washington Univ., Washington, D. C.
A COMPARISON OF THE UNITED STATES AND SOVIET SPACE PROGRAMS Paper No. 10
Richard W. Porter and Charles S. Sheldon Jun. 1965 84 p ref

The space accomplishments and programs of the United States, the Soviet Union, and other space oriented nations are reviewed and compared. Topics discussed are (1) space research in the physical sciences, (2) biological research in space vehicles and manned space flight, (3) development of large boosters, (4) lunar and planetary exploration, (5) practical applications, and (6) cooperation with other nations. It was established that so far, only the Soviet Union and the United States are officially committed at the highest level to carry out ambitious manned missions around the earth and to the moon or planets, but it does not appear that they will continue to monopolize space technology. Chronological tables of United States and Soviet space flights, and other tables of comparison of launch vehicles are included. L.S.

N65-29223*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLOD II: PLANETARY ORBIT DETERMINATION PROGRAM FOR THE IBM 7094 COMPUTER
Charles J. Devine 15 Apr. 1965 150 p refs
(Contract NAS7-100)
(NASA-CR-63944; JPL-TM-33-188) CFSTI: HC $4.00/MF $1.00 CSCL 22C

A double precision (DP) numerical fitting program for the IBM 7094, designated PLOD II, was developed in order to compute a gravitationally consistent position and velocity ephemeris of high accuracy. The DP program is designed to determine a definitive planetary orbit by fitting known source positions for a planet in such a manner that the residuals in longitude and latitude are as small as possible in a least squares sense. The method of integration and the least squares fitting technique are described in detail along with all mathematical equations used in the computation. R.N.A.

N65-29225# RAND Corp., Santa Monica, Calif.
A MODEL FOR PROJECTING COSTS OF SPACE EXPLORATION
J. String Apr. 1965 26 p Presented at a meeting of the Am. Statist. Assoc., S. Calif. Chapter, 28 Jan. 1965
(P-3119; AD-615517)

A long range planning model was developed for determining the costs of advanced space hardware and for assessing the budgetary implications of integrated space exploration plans. The model estimates the resource implications of alternative space plans to allow relating of resource requirements to the objective of the plans. It provides a basis for making decisions on major activities in the future and is designed to yield projections of the budgetary implications of space activity plans under serious data base implications and technological and operational uncertainties. R.N.A.

N65-29249*# National Aeronautics and Space Administration, Washington, D. C.
A WALK IN SPACE
[1965] 26 p GPO: $0.30 CSCL 22A

This educational publication by NASA describes the extended earth orbital mission in space by Gemini 4 and the first extravehicular activity (EVA) in the manned space program. Preflight preparations and the launch into orbit are pictorially presented, and comments from the astronauts' press conference document the pictures pertaining to the EVA feat. A transcript of the mission commentary, in which the astronauts, the flight director, the flight surgeon, and the capsule communicators participated during the walk in space, is also included. W.M.R.

N65-29299*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
ANALYSIS OF THE ERRORS ASSOCIATED WITH THE DETERMINATION OF PLANETARY ATMOSPHERE STRUCTURE FROM MEASURED ACCELERATIONS OF AN ENTRY VEHICLE
Victor L. Peterson Washington, NASA, Jul. 1965 23 p refs
(NASA-TR-R-225) CFSTI: HC $1.00/MF $0.50 CSCL 03B

An analytic method is developed for estimating the errors in the density and pressure structure of a planetary atmosphere constructed from measurements of accelerations experienced by an entry body. Among the sources of error considered both singly and collectively are the measuring accuracy of the accelerometers, the uncertainties in entry speed, entry angle, and aerodynamic coefficients, the frequency of data measurements, and the uncertainty of the attitude of entry bodies having nonzero lift-to-drag ratios. Results of sample calculations are presented to show the accuracy with which the extremes of a range of postulated model atmospheres for Mars can be defined upon measurements of accelerations experienced by a spherically shaped entry body. It is found that if the accelerometer method were used only over that portion of the atmosphere traversed at speeds greater than sonic speed, then any of the atmospheres postulated for Mars can be defined reasonably well even when errors from all sources are combined in the most unfavorable manner. Some of the results obtained by the analytic method are compared with those from more precise numerical calculations and the agreement is found to be excellent. Author

N65-29389*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
CHEMICAL FRACTIONATIONS IN METEORITES
Edward Anders Sep. 1964 24 p refs Submitted for Publication
(Grant NsG-366; Contract AT(11-1)-382)
(NASA-CR-59081; COO-382-47; EFINS-64-47) CFSTI: HC $1.00/MF $0.50 CSCL 03B

In a study of the chemical fractionations in meteorites it was not possible to find a single set of chemical and physical conditions consistent with the abundance pattern in chrondites. Instead, it was assumed that meteoritic matter is derived from at least two materials of contrasting chemical history. The simplest model that accounts for the present data assumes that the meteorites are a blend of two types of material: an undepleted fraction A rich in volatiles, and a depleted fraction B from which the volatiles were lost. The first became separated

from its cosmic complement of gas at a low temperature, and the second at a high temperature. Fractions A and B can be tentatively identified with low temperature and high temperature minerals in primitive unmetamorphosed chrondites. Wood's theory provides a framework for the origin of fractions A and B. Fraction A is unreheated or slightly reheated primordial dust while fraction B is primordial dust that was vaporized and recondensed during passage of a shock wave through the solar nebula and became chemically isolated from its gases at high temperatures. R.N.A.

N65-29394*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

DISCUSSION OF EXISTING AND PLANNED SIMULATORS FOR SPACE RESEARCH

A.W. Vogeley [1964] 42 p Presented at Conf. on the Role of Simulation in Space Technol., Blacksburg, Va., 11–21 Aug. 1964

(NASA-TM-X-54775) CFSTI: HC $2.00/MF $0.50 CSCL 22C

This paper discusses a variety of manned flight simulations that are particularly applicable to space research. Most of the simulators described are in operation, but are relatively new. Some of the simulators are still under construction or in the planning stage. A few of the simulators are nonexistent—that is, although the research problems have been defined, no satisfactory methods for adequately simulating the problems have been found. The facilities described have been selected either because they present new and novel methods for simulating some of the peculiar aspects of the space environment or because they contain unique construction or operational features that may have application to other simulation facilities. Author

N65-29411*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON THE SOLAR ORIGIN OF THE INTERPLANETARY MAGNETIC FIELD

Norman F. Ness and John M. Wilcox (California Univ., Berkeley) [1964] 14 p refs Submitted for Publication

(NASA-TM-X-54733) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The initial results of a detailed comparison of interplanetary magnetic field measurements taken by the Interplanetary Monitoring Platform (IMP-1) with solar magnetograph observations of the photospheric magnetic fields as measured at the Mt. Wilson Observatory are presented. Results indicate that during three solar rotations near the minimum of the solar cycle, some of the magnetic field lines passing through the photosphere near the center of the visible disk tended to be dragged out by the solar wind plasma to become part of the nearby interplanetary magnetic field. The best correlation was obtained when the photospheric field was in the same direction throughout an area corresponding to a least two or three days rotation. These conclusions are consistent with a suggested model in which the sense of the interplanetary magnetic field filaments is related to the sense of photospheric magnetic field regions. R.N.A.

N65-29424*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

THE ANALYSIS OF UNCO-OPERATIVE RADAR TARGETS

R.M. Goldstein [1964] 31 p refs

(Contract NAS7-100)

(NASA-CR-58803) CFSTI: HC $2.00/MF $0.50 CSCL 03A

Reported is an analysis of inherent problems associated with measuring the physical characteristics of uncooperative radar target planets such as Mars, Mercury, Jupiter, Venus, and the Moon. Emphasized are difficulties induced by inadequate amounts of power contained in planetary echoes, background noise, and the tremendous distances over which measurements must be made. Considered are theoretical and analytical aspects of: signal-to-noise, total power, power distribution in frequency, and power distribution in range, measurements. Also discussed is the combined use of range-gating and spectral analysis techniques (range-velocity mapping) to produce two-dimensional maps of target planet surfaces. S.C.W.

N65-29427*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MISSION AND DESIGN OF AN ORBITING RADIO ASTRONOMY EXPLORER

Robert G. Stone [1964] 12 p refs Submitted for Publication

(NASA-TM-X-51971) CFSTI: HC $1.00/MF $0.50 CSCL 03A

The proposed orbiting Radio Astronomy Explorer (RAE) has been demonstrated to be feasible for measuring the intensity of radio signals from celestial sources as a function of frequency, position, and time. Galactic, solar, and planetary studies are feasible with the RAE which will permit the detection of terrestrial noise storms and their distribution measurement at low frequencies. Observations of solar bursts over the proposed RAE frequency range will aid in studying the interaction between particle streams and coronal plasma. The proposed system could also provide the basic unit for future experiments to obtain high resolution surveys by means of aperture synthesis. The proposed RAE is essentially an orbiting directive antenna system, and experimental results have demonstrated that its elements can be at least 750 feet long and it can be placed into a 6000 kilometer circular orbit with a 50° inclination by a thrust-augmented Thor-Delta rocket with a Nots 1008 apogee kick motor. M.W.R.

N65-29429*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MODELS OF URANUS AND NEPTUNE

Ray T. Reynolds and Audrey L. Summers [1963] 33 p refs Submitted for Publication

(NASA-TM-X-51988) CFSTI: HC $2.00/MF $0.50 CSCL 03B

The equation of hydrostatic equilibrium and Clairaut's equation are integrated numerically to obtain mathematical models for solid bodies of planetary dimensions. Equations of state at 0° K for the more abundant materials within a solar mixture are estimated and mass-radius curves plotted for model planets composed of these materials. Sets of self-consistent models for Uranus and Neptune are computed upon the basis of a stated set of assumptions and the properties of these models are calculated and compared with available observational data. Author

N65-29433*# California Univ., Berkeley. Space Sciences Lab.

CONSOLIDATED QUARTERLY PROGRESS REPORT

27 Jul. 1964 65 p *Its* Ser. 5, Issue 37

(Grants NsG-243-62; NsG-126; NsG-101; NsG-479; NsG-600 et al)

(NASA-CR-59038) CFSTI: HC $3.00/MF $0.75 CSCL 22A

A broad multi-disciplinary program involving the physical, biological, engineering, and social sciences is reported. The studies in the social sciences cover a wide area of problems in management, operations analyses and decision making, the economic impact of the space program, and the international import of the space program. The projects in the physical, biological, and engineering sciences group into areas of space science as follows: *Planetary Atmospheres; Lunar Structure; Fields and Particles; Exobiology; Space Physiology;* and *Engineering Sciences*. Studies on detonation processes associated with various types of fuels and shock waves in gases, propulsion, and reaction kinetics are also included. Further, a project on kilovolt-ion sputtering has a twofold interest with respect to

space technology—the degradation of materials in space and ion propulsion. The project combines solid state physics and the physics of plasmas and rarefied gases. E.E.B.

N65-29437*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROTATIONAL BEHAVIOR OF THE MAIN-SEQUENCE STARS AND ITS PLAUSIBLE CONSEQUENCES CONCERNING FORMATION OF PLANETARY SYSTEMS
Su-Shu Huang [1962] 19 p refs Submitted for Publication
(NASA-TM-X-54732) CFSTI: HC $1.00/MF $0.50 CSCL 03C

A phenomenological theory for the behavior of axial rotation of main-sequence stars is proposed here by considering the effect of braking. It provides a statistical model by which histograms of observed rotational velocities of stars of different spectral types can be explained in terms of the braking strength. It shows that rotation of all stars including those of O and B type has been braked in various degrees during their course of evolution. As a result of braking, the stellar angular momentum is transferred outwards to the surrounding nebula that may be regarded as the remnant of star formation. It shows that the size of a planetary system around any star is critically dependent upon the mass in the nebula as compared to that of the star itself. Author

N65-29445*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ON THE SPECTRUM AND RELATIVE INTENSITIES OF INTERSTELLAR OH LINES
A. H. Barrett and A. E. E. Rogers [1964] 5 p refs Submitted for Publication
(Grant NsG-419; Contract DA-36-039-AMC-03200(E))
(NASA-CR-58808) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Fourteen microwave lines of various energy levels and isotopic species of OH lines in the interstellar medium are investigated. The line frequencies, theoretical relative intensities, and transition probabilities are tabulated. An unexpected result of the astronomical OH observations is that the intensities of the four $^2\Pi_{3/2}$, J=3/2 lines are in the ratios 1:2.2:2.7:1, whereas the theoretical values are 1:5:9:1. A possible explanation is the existence of many small condensations of large optical depth. L.S.

N65-29454*# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
THE IMPLICATIONS OF THE RANGER MOON PICTURES
T. Gold 11 Aug. 1964 9 p refs
(Grant NsG-382)
(NASA-CR-58463; CRSR-176) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The Ranger pictures leave no doubt that erosion is a major effect in shaping the lunar surface. Evidence for errosion occurrence on the lunar surface is presented. The Ranger pictures appear to show mostly a uniform, fine-grained material of low structural strength near the surface and in the first few meters depth. They show no hint of any transition to a different material below, such as a change in the appearence of deeper craters or an occasional out-crop of something looking like rock. It is therefore most likely that one is seeing the same type of material at all the depths excavated by the craters, but very probably in progressively greater compaction and cementation at the greater depth. The Ranger pictures have strengthened the case for dust as the main constituent of the lunar lowlands by not showing any rock formations. N.E.A.

N65-29458*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HIGHLIGHTS OF RECENT SPACE RESEARCH
Robert Jastrow and A. G. W. Cameron [1964] 65 p refs Submitted for Publication
(NASA-TM-X-51903) CFSTI: HC $3.00/MF $0.75 CSCL 03B

Space sciences is the collection of scientific problems to which space vehicles can make some specific contributions not achievable by ground-based experiments. At the present time this field includes broad segments of the traditional disciplines of the earth sciences, physics, and astronomy. In later years the biological sciences will join this group in an important role, as our explorations of the moon and planets provide us with opportunities for studying the conditions under which physical life may have developed. The present article reviews some highlights of recent space research in the physical sciences. Author

N65-29475*# California Univ., Berkeley. Space Sciences Lab.
THE EVIDENCE FOR LIFE ON MARS: NATURE AND UNCERTAINTIES
D. G. Rea [1964] 50 p refs
(Grant NsG-101)
(NASA-CR-58430) CFSTI: HC $2.00/MF $0.50 CSCL 03B

A review of the current Martian environment and the question of life on Mars is presented. Some of the physical properties of Mars are tabulated and include mass (0.646×10^{27} g), diameter (6800 km), average density (3.96 g cm^{-3}), and mean distance from the sun (228×10^6 km). Pressure, temperature, and gases present in the atmosphere are among other areas discussed, but it is pointed out that no universal agreement between scientists has been reached. Canals, vegetation, seasonal variations, dust clouds, and radiations are also discussed, with possible explanations relating to life on Mars presented, but again no universal agreement has been reached. C.T.C.

N65-29486*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
ON THE EVOLUTIONARY STATE OF BETA CEPHEI STARS
Richard Stothers [1964] 45 p refs Submitted for Publication
(NASA-TM-X-51934) CFSTI: HC $2.00/MF $0.50 CSCL 3B

An attempt was made to explain the β Cephei variables as non-rotating stars undergoing radial oscillations, on the basis of their relatively low observed rotational velocities. Based on the central condensation and the time scale of evolution, observed numbers indicated that B0.5 – B2 giants were in the hydrogen-burning phase. The pulsational characteristics were obtained by perturbing the stable models in the usual adiabatic approximation. The hypothesis of evolution of main sequence O9–B1 stars across the instability strip seems correct. Theoretical and observational arguments indicated that the effects of rotation and mass loss were small. The period-luminosity relation, observed luminosity classes, and location of the Trumpler turn-off in clusters, confirmed the prediction that the β Cephei stars of lower mass fall closer to the initial main sequence. R.W.H.

N65-29491*# Arizona Univ., Tucson.
THE WAVELENGTH DEPENDENCE OF POLARIZATION. III: THE LUNAR SURFACE Final Report
T. Gehrels, T. Coffeen, and D. Owings 31 Jul. 1964 2 p Prepared jointly with Indiana Univ., Bloomington
(Grant NsG-493)
(NASA-CR-58739) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Photometric and polarimetric observations of the moon and other objects were obtained. Reductions were greatly facilitated by the use of digitized equipment. Calculations were

made on the Mie theory of brightness and polarization predicted for spherical particles with a range of size and refractive index. The calculations were used on the particles in the surface layer of the moon. The results of the observations and the Mie calculations are presented. R.N.A.

N65-29509# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
UNITED STATES SPACE SCIENCE PROGRAM
1965 316 p refs Submitted to the 8th Meeting of COSPAR, Buenos Aires, May 1965

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N65-29511 National Academy of Sciences—National Research Council, Washington, D. C.
BIBLIOGRAPHY ON SPACE SCIENCES, 1964
In its U. S. Space Sci. Program, 1965 152 p (See N65-29509 18-30)

A bibliography of space science literature published in the United States during 1964 is listed under 12 headings and a general category. Subject categories include celestial mechanics, trajectory studies, gravity, and geodesy; tracking, telemetry, and space communications; instrumentation and techniques; interaction between space vehicle and medium; atmospheric composition and structure; ionospheric physics; energetic particles and magnetic fields; meteorites, cosmic dust, and tektites; the sun; the moon and planets; astronomy; and the life sciences. M.W.R.

N65-29582# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROBLEMS OF OPTIMUM CONTROL OF THREE DIMENSIONAL MOTION OF SPACE VEHICLES
R. V. Studnev 25 May 1965 23 p refs Transl. into ENGLISH from a Soviet publ.
(FTD-MT-65-120; AD-615854)

There are investigated questions of optimum pulse control of the spatial orientation of an axially symmetric space vehicle (SV). It is assumed that control of the SV is carried out by two pairs of control jets (CJ), one of which is fastened in the vehicle and creates a moment about the axis of symmetry, and the second pair is fixed in a cardan suspension and can create a moment about any axis orthogonal to the axis of symmetry of the apparatus. The following problems are solved: (1) Optimum control of orientation of the axis of rotation which is the axis of symmetry of the SV. There are determined conditions under which control of orientation can be carried out by one pair of CJ fastened in the vehicle; (2) Optimum control of orientation of the SV rotating about a principal axis of inertia which is not the axis of symmetry; and (3) Optimum control of the spatial orientation of an axially symmetric SV in general. Author

N65-29599*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH ON THE MOTION OF MINOR PLANETS [RECHERCHES SUR LE MOUVEMENT DES PETITES PLANETS]
H. v. Zeipel Jul. 1965 249 p refs Transl. into ENGLISH from Ark. Mat. Astr. Fys. (Uppsala), v. 11, no. 1–2, art. 1 and 7, 1916; v. 12, no. 1–3, art. 9, 1917; v. 13, no. 1–2, art. 3, 1918
(NASA-TT-F-9445) CFSTI: HC $6.00/MF $1.50 CSCL 03C

Semiconvergent trigonometric series in powers of a small parameter, based on Poincaré's methods, are applied to a qualitative theory on the motion of minor planets and on the origin of gaps in the interplanetary asteroid belt. The asteroids are grouped into characteristic ordinary, singular, regular, and critical planets whose mean absolute motion is compared with that of Jupiter. A formal theory is developed for critical planets of the (p + q): p type, and the absence of gaps in the asteroid belt at $q \geq 5$ is explained by the derived fact that the motion of "critical" minor planets is stable above this value. Author

N65-29613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF ORBITS OF OBJECTS IN OUTER SPACE WITH THE HELP OF AN AUTOMATED MEASURING COMPLEX
E. L. Akim, M. L. Kislik, P. Ye. El'yasberg, and T. M. Eneyev 19 May 1965 8 p refs Transl. into ENGLISH from Russian
(FTD-MT-65-122; AD-615856)

A mathematical method for estimating the orbits of objects in outer space is described. The method involves observing the trajectory of an object at a series of points. An a priori assumption of the distribution of measurement errors is required. The sequence of observations is treated as a series of correlated values which are used in finding values for the unknown orbit parameters. The technique of maximum likelihood is employed in deriving the mathematical form of the estimates. Newton's method of generalized tangents is shown as a convenient means of evaluating the estimation expressions, although the method of steepest descent is more accurate. J.M.D.

N65-29614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SURVEY OF WORKS CARRIED OUT IN COMPUTATIONAL CENTER OF ACADEMY OF SCIENCES OF USSR ON THE THEORY OF OPTIMAL CONTROL OF SPACECRAFT
N. N. Moiseyev and V. N. Lebedev 25 May 1965 28 p refs Transl. into ENGLISH from Russian
(FTD-MT-65-123; AD-615857)

Two approaches to the solution of variational problems of spacecraft control are demonstrated. Problems using the principle of the maximum were discussed, and a very high accuracy of calculations was obtained. All calculations were carried out with very high degree of accuracy and in this sense the given results have a 'final character'. Methods of dynamic programming require a considerably smaller number of 'machine hours.' For their use there is no necessity to have a good first approximation. However, they are inferior to classical methods in the sense of accuracy. Schemes of only the first order of accuracy, equivalent to the scheme of integration of Euler, were considered. (TAB)

N65-29618# California Univ., Berkeley. Space Sciences Lab.
A CONDUCTING PERMEABLE SPHERE AND CYLINDER IN AN ELLIPTICALLY POLARIZED ALTERNATING MAGNETIC FIELD
S. H. Ward and D. C. Fraser 30 Apr. 1965, 43 p refs *Its* Ser. No. 6, Issue No. 14
(Contract Nonr-222(89))
(AD-616259)

Formulation for the conducting permeable sphere and cylinder in an elliptically polarized alternating magnetic field is presented. Graphically displayed are the inducing, induced, and total magnetic fields for various values of the ellipticity and azimuth of the inducing ellipse and for various values of the induction number $\theta = (\sigma\mu\omega)^{1/2}R$ and permeability $K_m = \mu_2/\mu_1$ pertaining to a sphere and a cylinder. Substantial differences can exist between inducing and resultant ellipses, measured in the horizontal plane, in the vicinity of a conductivity inhomogeneity such as a sphere or a cylinder. Additionally, a polarization ellipse appears in any vertical plane in the vicinity of an inhomogeneity. Since substantial changes are introduced in a measured field ellipse by the presence of an inhomogeneity, these effects must be considered when induction studies of the Crust are made. Hence in the discussion we note some of the peculiarities to be expected when applying the magnetic variation, magnetotelluric and AFMAG methods. Author

N65-29655*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NATURE OF THE SPACE ENVIRONMENT
John C. Evvard [1964] 39 p ref Presented at the 7th Ann. Missile and Space Tech. Inst., Storrs, Conn., 22 Jul. 1964
(NASA-TM-X-51961) CFSTI: HC $2.00/MF $0.50 CSCL 22A

In discussing the nature of the space environment, emphasis was placed on solar space and the solar system. Radiation including light, radiowaves, and X-rays, and force fields such as gravity, electrostatic attractions, and magnetic fields are discussed, and probabilities of cosmic rays, solar winds, and lethal radiations associated with solar flares are considered. The functions of Explorer, the weather, and communications satellites are outlined, and planetary environments for manned exploration are briefly discussed. Among the data presented are graphs and tables on solar flares, the chemical composition of cosmic radiation, meteoroid penetration rate, and meteoroid mass-frequency distribution. C.T.C.

N65-29666# Centre National d'Etudes Spatiales, Paris (France).
SPACE RESEARCH [LA RECHERCHE SPATIALE]
Jul. 1965 70 p refs In FRENCH *Its* Bulletin d'Information Mensuel, V. 4, No. 7 Available from Centre Natl. d'Etudes Spatiales: 3 Fr.

Fourteen brief articles on space science and technology are presented. Topics covered are the June 1965 Gemini flight, recent research on cosmic rays, a sounding technique based on resonance of radio waves, use of the Alfven effect for propulsion of satellites in the atmosphere, stabilization of satellites with the aid of the gradient of terrestrial gravity, infrared measurement in space explorations, sterilization of space equipment, space vehicle surface layers and the control of temperature, recent testing of Saturn 1, launching of Pegasus 2, satellite for detection of meteorites, launching of the third IMP, review of French space science activities during 1964, navigation satellites, preliminary experiments for study of interplanetary space with artificial ionized clouds, and an artificial skeleton device to facilitate the physical motions of astronauts in space flight. Transl. by J.M.D.

N65-29687# Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF THE MOON'S SHAPE ON THE MOTION OF ARTIFICIAL MOON SATELLITES [VLIYANIE FIGURY LUNY NA DVIZHENIE ISKUSSTVENNYKH SPUTNIKOV LUNY] G. A. Chebotarev and S. N. Kirpichnikov London, Min. of Aviation, Mar. 1965 23 p refs Transl. into ENGLISH from Bull. Inst. Theoret. Astron., v. 8, no. 5, 1962 p 324-335
(RAE-LIB-Trans-1108)

This paper shows the effect of the moon's shape on the motion of artificial moon satellites. Four types of orbit are examined: (1) a polar orbit of small eccentricity; (2) an equatorial orbit of small eccentricity; (3) a polar orbit of large eccentricity; and (4) an equatorial orbit of large eccentricity. The secular displacements caused by the moon's shape of the lines of apsides have been determined. Author

N65-29697# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMIZATION OF FLIGHT CONTROL OF SPACECRAFT
A. K. Platonov, A. A. Dashkov, and V. N. Kubasov 19 May 1965 15 p refs Transl. into ENGLISH from RUSSIAN
(FTD-MT-65-125; AD-615858)

In this report are investigated properties of optimum processes of flight control of spacecraft in the case when there is available complete information about motion, and when control is produced with the purpose of maintaining given values of certain functionals on the trajectory. Such functionals can be parameters of the trajectory characterizing conditions of encounter with a planet or another apparatus in outer space, or parameters determining spatial position of apparatus at a fixed moment of time. N.E.A.

N65-29719*# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
INVESTIGATION OF SPUTTERING EFFECTS ON THE MOON'S SURFACE Eighth Quarterly Status Report, 25 Jan.-24 Apr. 1965
G. K. Wehner, D. L. Rosenberg, and C. E. KenKnight 14 May 1965 58 p refs *Its* Rept.-2792
(Contract NASw-751)
(NASA-CR-64022) CFSTI: HC $3.00/MF $0.50 CSCL 03B

Measurements of photometric and polarimetric properties of sifted powder surfaces have been obtained for the materials greenstone and tektite for the particle size ranges 0-20, 20-44, 44-74, and 74-300μ in addition to earlier data for tholeiitic basalt and granodiorite. The surfaces were darkened by simulated solar-wind bombardment. The normal albedos and photometric function were measured in ultraviolet, green, and red light and indicated fair agreement with lunar measurements in the small-

size ranges after bombardment by the equivalent of 10^4 to 10^5 yr of solar-wind exposure. Two indices of the polarization of green light scattered from these rock powder surfaces were shown to increase equivalently with particle size. Comparison to lunar values of the polarization indices and albedo indicated that most of the particles in the lunar dust cover are less than 50 or 100μ in diameter if the umbombarded particles are opaque or translucent, respectively. Some uncertainty in this conclusion arises from the interpretation of the lunar albedo at zero phase angle. Author

N65-29731*# National Aeronautics and Space Administration, Washington, D. C.
CERTAIN ADVANCES IN METEORITICS [NEKOTORYYE USPEKHI METEORITIKI]
V. G. Fesenkov Jul. 1965 26 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 24, 1964 p 5–15
(NASA-TT-F-9484) CFSTI: HC $2.00/MF $0.50 CSCL 03B

Presented is an analysis of previous discoveries and hypotheses concerning the origin of meteorites. Included is a discussion of tektites. Further studies on the presence of gases in meteorites and of isotopes existing in them are recommended in view of the complexity of the conditions under which the solar system was formed. S.C.W.

N65-29744*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-33, VOLUME VI FOR THE PERIOD MARCH 1, 1965 TO APRIL 30, 1965. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 May 1965 38 p ref
(Contract NAS7-100)
(NASA-CR-64029; JPL-SPS-37-33, Vol. VI) CFSTI: HC $2.00/MF $0.50 CSCL 22A

A summary of activities in the lunar, planetary, and interplanetary space programs; the deep space network; supporting activities; and space sciences is presented. Included are TV subsystem performance, space flight operations, and guidance and control for the Ranger Project; systems testing, space flight operations, telecommunications, flight control, propulsion, and testing facilities and equipment for the Surveyor Project; and space flight operations, attitude control subsystem performance, and a star identification procedure for the Mariner Project. Also discussed are tracking stations engineering and operations, and development and testing activities for the deep space instrumentation facility; modifications to a refrigerant valve for increased reliability at cryogenic temperatures for the environmental test facilities; and data automation system life testing for Mariner II space instrument systems. R.N.A.

N65-29751 General Dynamics/Astronautics, San Diego, Calif. Life Sciences Section.
MAN IN SPACE TODAY
D. P. Germeraad *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 3–8 (See N65-29750 18-05)

The life sciences role in providing man's requirements to perform and survive in space flight operations is discussed. Present research efforts in such areas as biomedical monitoring, physiology, toxicology, a rotating space station, and an advanced life support system are described. R.N.A.

N65-29771 Boeing Co., Seattle, Wash. Aero-Space Div.
USE OF BOOLEAN ALGEBRA IN ORBITAL FLIGHT ANALYSIS
Gordon Willard *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 261–273 refs (See N65-29750 18-05)

The study shows how the Boolean algebra technique can be used to arrive at engineering solutions to problems with signal output criteria. The Karnaough mapping technique is described. Both of these methods are applied to a safety analysis of an orbital flight. R.N.A.

N65-29786*# National Aeronautics and Space Administration, Washington, D. C.
NEWS CONFERENCE ON INITIAL SCIENTIFIC INTERPRETATION OF MARINER IV PHOTOGRAPHY
29 Jul. 1965 56 p
Available from the Scientific and Technical Information Division CSCL 22A

A transcript of the NASA press conference held to interpret 21 of the photographs returned from Mariner IV is presented. Surface details are described in relation to distance, to the direction of the sun's illumination, and to the viewing angle. The size of various craters were pointed out, and their implications discussed. Details were also given on the data processing of the pictures, the further refinements to be expected, and the camera arrangement. Such topics as temperature, atmosphere, the type of surface, and the possibility of life on Mars were discussed in the question and answer period. M.G.J.

N65-29799# Boeing Scientific Research Labs., Seattle, Wash.
REVIEW, GEO-ASTROPHYSICS LABORATORY, JULY–DECEMBER 1964
Feb. 1965 22 p refs

Continuing research programs currently include investigations of lunar temperature, cosmic ray neutrons, geomagnetic micropulsations, ratio star scintillations, microwave scattering, very low frequency wave propagation, and magnetohydrodynamic flow. The last-mention study is theoretical; the others are based on experiment. In addition to these programs, theoretical studies have recently been started on x-radiation transfer and the transport of charged particles in disordered magnetic fields. Another field of operation was the installation of micropulsation measurement equipment for a conjugate-point experiment near the geomagnetic poles, at Thule, Greenland and Vostok, Antarctica. One other remote operation has been the recording of cosmic ray neutron data over South America with neutron spectral equipment installed in a KC-135 aircraft. The data obtained have established the location of the cosmic ray equator at three longitudes in the South America area; this has permitted a comparison to be made between experiment and several theoretical models. Details of these activities are given. N.E.A.

N65-29804*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SOLUTION OF DELAUNAY'S EQUATIONS OF TYPE II
Theodore L. Felsentreger Apr. 1965 20 p refs
(NASA-TM-X-55252; X-547-65-160) CFSTI: HC $1.00/MF $0.50 CSCL 03C

An analytic solution of Delaunay's Equations of Type II is obtained. The results can be applied to artificial satellite problems, including satellites of small eccentricity. Author

N65-29810*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A SUMMARY OF RESULTS FROM THE IMP-I MAGNETIC FIELD EXPERIMENT

Norman F. Ness, Cleil S. Scearce, Joseph B. Seek, and John M. Wilcox May 1965 96 p refs Presented at COSPAR Meeting, Buenos Aires, May 1965 Submitted for Publication (NASA-TM-X-55258; X-612-65-180) CFSTI: HC $3.00/MF $0.75 CSCL 22A

The first Interplanetary Monitoring Platform (IMP-I) has provided the first accurate measurements of the interplanetary magnetic field, the magnetosphere boundary and the collisionless magnetohydrodynamic shock wave associated with the solar wind interaction with the geomagnetic field. Measurements were made from the subsolar point to the nighttime magnetic tail and included a mapping of the Earth's magnetic field within the magnetosphere. The experimental detection of an extended magnetic tail on the nighttime side of the Earth and the enclosed magnetically neutral sheet represents the most recent important results with respect to the Earth's outer magnetic field. This paper presents a summary of the results of these detailed measurements and the experimental data yielding the interpretation of these various phenomenon. Previous reports on the initial results of the magnetic field are expanded upon and the magnetic field topologies both in interplanetary space and within the magnetosphere are discussed. N.E.A.

N65-29833# Academy of Sciences (USSR), Moscow. Astronomical Council.

OPTICAL OBSERVATION STATIONS FOR ARTIFICIAL EARTH SATELLITES, BULLETIN NO. 36 [STANTSII OPTICHESKOGO NABLYUDENIYA ISKUSSTVENNYKH SPUTNIKOV ZEMLI, BYULLETEN' NO. 36]

1963 36 p refs In RUSSIAN; ENGLISH summary

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N65-29834 Academy of Sciences (USSR), Moscow. Astronomical Council.

AT TWO POINTS CONFORMAL ORTHODROMIC PROJECTION FOR LOCATION OF SUBSATELLITE-BIAZIMUT-CHART [RAVNOUGOLNAYA V DVUKH TOCHKAKH ORTODROMICHESKAYA PROYEKTSIYA DLYA OPREDELENIYA POLOZHENIYA ISZ (SETKA BIAZIMUT)]

Gy. Erdi-Kraus *In its* Opt. Observation Sta. for Artificial Earth Satellites, Bull. No. 36 1963 p 3-7 refs (See N65-29833 18-30)

Described is a method for determining the geographical position of subsatellite points. The proposed projection is conformal at two measuring stations, and owing to its orthodromic property the bearings are represented as straight lines. The intersections of the bearings on the projection give the immediate geographic position of subsatellite points. S.C.W.

N65-29835 Academy of Sciences (USSR), Moscow. Astronomical Council.

A SATELLITE PLANISPHERE [SPUTNIKOVAYA PLANISFERA]

R. Janichek *In its* Opt. Observation Sta. for Artificial Earth Satellites, Bull. No. 36 1963 p 8-13 (See N65-29833 18-30)

Described is a method which allows, on the basis of known orbital elements, determinations of a visual topocentrical trajectory of a satellite on the celestial sphere. The method consists of a sky map and transparent films with corresponding nets plotted on them. The method also allows the derivation of more accurate orbital elements by comparing observations with known orbital elements. S.C.W.

N65-29837 Academy of Sciences (USSR), Moscow. Astronomical Council.

SYNCHRONOUS OBSERVATIONS OF THE ARTIFICIAL EARTH SATELLITE ECHO-1 IN 1963 [SINKHRONNYE NABLYUDENIYA SPUTNIKA EKHO-1 V 1963 GODU]

D. E. Shebolev *In its* Opt. Observation Sta. for Artificial Earth Satellites, Bull. No. 36 1963 p 21-22 ref (See N65-29833 18-30)

Discussed are plans to synchronize observations of the artificial satellite Echo-1 during May and June of 1963, which were initiated at the November 1962 meeting of the Soviet Academy of Sciences. Participating were stations located in middle and eastern Europe which were engaged in the photographic observation of artificial earth satellites. More than 1000 synchronous negatives were obtained as a result of this program. Included is a general discussion of the geographical locations of the participating stations. Transl. by S.C.W.

N65-29838 Academy of Sciences (USSR), Moscow. Astronomical Council.

ON THE BRIGHTNESS VARIATION OF THE SATELLITE "ECHO-1" [YESHCHO RAZ OB IZMENENII BLESKA SPUTNIKA "EKHO-1"]

M. V. Bratiitchuk and G. V. Moskalova *In its* Opt. Observation Sta. for Artificial Earth Satellites, Bull. No. 36 1963 p 23-29 refs (See N65-29833 18-30)

Photographically obtained photometric curves of the artificial earth satellite Echo-1 are presented. Discovered was a brief period of the brightness variation of Echo-1. An attempt is made to explain this phenomenon on the basis of the reflecting surface of the object. S.C.W.

N65-29854# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

ON THE FIGURE AND GRAVITY FIELD OF THE MOON

C. L. Goudas Feb. 1965 18 p refs *Its* Mat. Note No. 395 (DI-82-0414)

The harmonic analysis of all available data shows that the figure of the Moon bulges in, approximately, the direction toward the Earth. Its radius in this direction exceeds the average radius of the disc by about 3 km. The ellipsoidal is not a good representation of the lunar figure because the third and fourth harmonics are present. The second harmonic can only explain one third of the lunar bulge. The rest is distributed over the higher harmonics. The analysis of the physical librations has shown that the shortest axis of the ellipsoid of inertia coincides roughly with the axis of rotation-which implies that the disc must be oblate if the Moon is homogenous, or nearly so. A Fourier analysis of the limb on the basis of previous data shows that the major axis of the elliptical component makes

an angle of about 60° with the equatorial axis. It implies that the Moon is inhomogenous either by structure or because of compensation and compaction. There is no reason why this conclusion should hold for the Marginal Zone only and not the entire body. However, the inhomogeneity does not appear substantial and the gravity field can be approximated by means of the surface harmonics and assumption of homogeneity. N.E.A.

N65-29859# Virginia Polytechnic Inst., Blacksburg. Virginia Engineering Experiment Station.
THE HODOGRAPH AND ITS APPLICATION TO SPACE FLIGHT
James B. Eades, Jr. Dec. 1964 107 p refs *Its* Bull. Vol. 157, No. 10

Hodograph equations were calculated for gaining fundamental understanding of central force field orbits and trajectories in space flight paths. The hodograph equation is generally developed, and is applied to the solution of example cases. The Orbital speed, acceleration, time, trajectories, transfer, geometry, and other parameters in terms of hodograph relations are considered in terms of hodograph relations. L.S.

N65-29868# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LABORATORIES IN SPACE
S. Vervov 14 May 1965 6 p Transl. into ENGLISH from Izvestiya (Moscow), Jul. 15, 1964 p 6
(FTD-TT-64-1361/1; AD-615986)

Various commentaries on the launching of Elektron 3 and Elektron 4 are reported. It was pointed out that information from the satellites is expected to supplement data on radiation belts obtained from the Elektron 1 and Elektron 2, and should help establish the spatial arrangement of the radiation belt and the change in radiation intensity with time. Maps of the radiation belts can be compiled, and the processes which bring about changes in the maps should be understood better. It was also noted that apparatus aboard the spacecraft should make it possible to study at great altitudes the composition of substances containing electrically charged particles of low energy, and permit the magnetic field of the earth to be studied. As the Elektron 3 and Elektron 4 move in different orbits, simultaneous measurements in two different areas of space, could greatly expand the possibilities of research. Difference measurements can also be obtained by the twin satellites. L.S.

N65-29896# RAND Corp., Santa Monica, Calif.
THE OPTIMIZATION OF INTERPLANETARY ORBIT TRANSFERS BY DYNAMIC PROGRAMMING
F. T. Smith Jul. 1965 179 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4622-PR; AD-617327)

This Memorandum contains an investigstion of the convergence of a computational method for optimizing interplanetary orbit transfers influenced by gravitational perturbations. The investigation is divided into three parts. First the necessary computational equations are derived. Next; the convergence of the computational process is investigated analytically. Finally, the results of a numerical investigation are presented. Author

N65-30030# Air Force Systems Command, Griffiss AFB, N. Y. Rome Air Development Center.
A METHOD FOR CONTROLLING THE ATTITUDE OF A SATELLITE USING THE EARTH'S MAGNETIC FIELD
Wilfred Joseph Minkus Sep. 1964 32 p
(RADC-TDR-64-394; AD-614652)

The report investigates a means of controlling the attitude of a satellite in a circular orbit about the earth by the torque due to the interaction between the earth's magnetic field and the magnetic moments produced by currents in three orthogonal coils aboard the satellite. This system has the advantage over more conventional ones in that no mass is expended in the control process. It is designed to rotate the satellite about its longitudinal axis in a minimum amount of time while limiting the deviation of this axis from the local normal to the earth. The analysis is limited to the period during which the satellite's attitude is being changed by magnetically produced torques. When these torques are not applied, gravity gradient effects act as a restoring force to align the longitudinal axis with the local normal to the earth. The method is applicable to a satellite with symmetry such that the moment of inertia about its longitudinal axis is much smaller than those about body-fixed axes lying in a plane perpendicular to it and whose moments of inertia about axes in this plane are approximately equal. Author

N65-30050*# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Grumman Research Dept.
PHOTOMETRIC MEASUREMENTS OF SIMULATED LUNAR SURFACES
J. D. Halajian Jan. 1965 121 p
(Contract NAS9-3182)
(NASA-CR-65083; RM-262) CFSTI: HC $4.00/MF $1.00
CSCL 03B

A photometric investigation of natural specimens at 0°, 30°, and 60° viewing angles, and of geometric solids covered by a backscattering powder is described. Furnace slag, volcanic ash, coral, foam, carborundum, and metallic meteorite are among the specimens considered, and the results are given in graphical form. Artificial and controlled models were used in an attempt to develop an intuitive and, if possible, an analytical grasp of how the geometrical properties of the lunar surface, or any surface, emerge from its photometric properties. The effects of surface roughness, albedo, grain size, and porosity were also investigated, and graphical results are presented. Results confirmed the conclusion that it is unnecessary to postulate a layer of dust on the moon in order to account for lunar photometric data; neither can the presence of lunar dust be ruled out on the basis of these data. C.T.C.

N65-30065# California Univ., Livermore. Lawrence Radiation Lab.
CALCULATION OF STELLAR STRUCTURE USING AN IONIZATION EQUILIBRIUM EQUATION OF STATE
Carl A. Rouse 7 Jan. 1965 29 p Revised
(Contract W-7405-ENG-48)
(UCRL-7820, Rev. 1)

An ionization equilibrium equation of state (IEEOS) is used in explicit difference equations describing the equilibrium of a self-gravitating, nonrotating gaseous sphere. Applied to the solar problem, this method has accomplished the first known continuous calculation of the sun's mass, radius, luminosity, and structure of the photosphere interior to the 5800° K radius. It was necessary to include a varying helium abundance before the solar radius could be calculated. A photospheric H/He ratio of 20 is shown to be compatible with a central temperature, T_c, of about 19.5×10^6° K and a central density, ρ_c, of about 36 g/cc; whereas a H/He ratio of 5.55 is compatible with a T_c of about 21×10^6° K and ρ_c of about 30 g/cc. A significantly different abundance of carbon-nitrogen than usually given for the core would alter the indicated values of T_c and ρ_c. The ability to calculate the structure of the photosphere between optical depths of 0.5 and 2 in calculations from the center is

demonstrated, hence the establishment of a good H/He ratio as well as variations of temperature and electron pressure in the visible portion of the photosphere would help to establish the interior structure of the sun. The calculated mass and radius are shown to depend on the high density formulation of the IEEOS. Author

N65-30070# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
COMPARISON OF COLOR AND COEFFICIENTS OF BRIGHTNESS OF DIFFERENT REGIONS ON THE LUNAR SURFACE WITH SOME TERRESTRIAL ROCKS
N. P. Barabashev and A. T. Chekirda Apr. 1965 11 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 33, no. 4, 1956 p 549–555
(RSIC-403; AD-616537)

A comparison of the color and the coefficients of brightness of typical lunar formations with those of some terrestrial substances was made by photographic observations with five light filters: infrared, red, green, blue, and ultraviolet. It was shown that the reflecting power of the lunar surface for the solar spectrum increases towards the red and infrared parts of the spectrum. Of the substances investigated, red quartz porphyry, quartz sandstone, auripigmentum, and volcanic tuff and ashes are most similar to the lunar surface. Average colors of various lunar formations, and the differences in stellar magnitudes for the various regions of the lunar surface, in relation to a white screen, are tabulated. C.T.C.

N65-30090# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN REMARKS ON THE ROLE OF RADIATION EFFECTS IN THE THEORY OF ASTRAL SHOCK WAVES
I. A. Klimishin 18 May 1965 5 p refs Transl. into ENGLISH from Vopr. Kosmogonii, Akad. Nauk SSSR, v. 9, 1963 p 200–202
(FTD-TT-65-82/1; AD-617657)

The effects of radiation on astral shock wave parameters are considered, and equations are given for determining the temperature behind the front of a shock wave in a star shell, and the density and temperature of a shock wave moving in a gas-radiation mixture. Expressions are also evolved for obtaining the growth of radiation intensity before the appearance of shock wave on the surface is evident. M.W.R.

N65-30143# California Univ., Berkeley. Inst. of Engineering Research.
A COMMENT ON DRUCKER'S POSTULATE IN THE THEORY OF PLASTICITY
A. E. Green (Newcastle upon Tyne Univ.) and P. M. Naghdi Apr. 1965 12 p refs
(Contract Nonr-222(69))
(AM-65-4; AD-617169)

A general theory of an elastic-plastic continuum, valid for non-isothermal deformations and accompanied by explicit thermodynamical restrictions, was developed recently by Green and Naghdi. A special case of this theory, assuming isothermal conditions, leads to constitutive relations which are equivalent to those which can be derived from Drucker's postulate. Here, we discuss further the implication of Drucker's postulate in connection with a set of constitutive equations for an elastic–plastic continuum in which the postulate need not be satisfied. Author

N65-30161# Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.
SOLAR RADIO NOISE REGISTRATIONS AT THE OSLO SOLAR OBSERVATORY, 1960–1964 Scientific Report No. 7 (56)
Oystein Elgaroy [1965] 86 p ref Repr. of Rept. No. 16 in the Rept. Ser. of the Inst. of Theoret. Astrophys.
(Contract AF 61(052)-743)
(AFCRL-65-366; AD-617566)

Observational data on solar radio noise made at the Oslo solar observatory for the period 1960 to 1964 are presented. The method of data tabulation is described and measurements which show how the data compared with those of some other observatories are discussed. R.N.A.

N65-30169# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SIGNIFICANCE OF PHOTOGRAPHIC METEOR DATA IN THE DESIGN OF METEOROID PROTECTION FOR LARGE SPACE VEHICLES
Nestor Clough and Seymour Lieblein Washington, NASA, Aug. 1965 43 p refs
(NASA-TN-D-2958) CFSTI: HC $2.00/MF $0.50 CSCL 22A

Described herein are the method of obtaining photographic meteor data in the mass range of 10^{-2} to 10^{0} gram and the treatment of these data to provide useful engineering relations for protecting large space vehicle components against meteoroid impact. The assumptions needed to convert these data to meteoroid masses and densities are discussed, and the effects of these assumptions on design relations are shown. The inferred nature and values of meteoroid density, mass, and velocity are described, and an internally consistent meteoroid mass flux model is introduced for the photographic meteoroid range. Earth shielding factors as a function of satellite altitude are presented for use with the proposed model. Values of average meteoroid density and average meteoroid velocity relative to the Earth at the Earth's atmosphere lower than values previously used are indicated by an analysis of the available photographic meteor data. Photographic meteor astronomy is shown to be a significant source of data in describing the meteoroid hazard in space. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-29169# British Aircraft Corp., Stevenage (England). Guided Weapons Div.
THE PRECESSION CHARACTERISTICS OF THE UK-3 SATELLITE DUE TO AERODYNAMIC TORQUES
Pauline Pearson May 1965 20 p refs *Its* Tech. Note ST-430 (UK-3/TN-47)

The aerodynamic torques which might affect the direction of the spin axis of the UK-3 satellite are examined. At high orbits above 1000 km, this change in direction is negligible, but at lower orbits the aerodynamic torques are much greater and thus the change in direction of the spin axis is correspondingly more marked. Because very little work has been done on the precession rate due to aerodynamic torques, different approaches to the problem were compared in an effort to establish a reasonable set of values for the precession rates for different orbit heights. Precession rates predicted for orbit heights of 300, 400, 500, 600, 700, and 800 km are 7.4, 1.6, 0.440, 0.140, 0.048, and 0.0175 degrees per day, respectively. E.E.B.

N65-29296*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VISUAL PRESENTATION OF THE MOTION AND ORIENTATION OF AN ORBITING SPACECRAFT (OGO)
Michael Mahoney and John Quann Jul. 1965 17 p
(NASA-TN-D-2918) CFSTI: HC $1.00/MF $0.50 CSCL 22B

The motion and orientation of an orbiting spacecraft are normally represented by vectors and angles in the various coordinate systems (celestial inertial coordinates, spacecraft coordinates, geodetic coordinates, etc.); and it is difficult to interpret spacecraft behavior in terms of actual orbital position and attitude. Motion and orientation information for a particular satellite (OGO) have been analyzed by the 1107 computer (Univac) and the 4020 microfilm plotter (Stromberg–Carlson), and numerical data on satellite behavior were made available. The data were then used to create a motion picture film illustrating satellite attitude in orbit. Author

N65-29396*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEMS OF FORCE MEASUREMENTS AND WEIGHING FOR THE DEVELOPMENT OF ROCKETS AND SPACE VEHICLES
W. A. Menzel [1964] 22 p Presented at 45th Ann. Tech. Conf., Natl. Scale Men's Assoc., Liberty, N. Y., 21 Apr. 1964
(NASA-TM-C-54771) CFSTI: HC $1.00/MF $0.50 CSCL 22B

A review of problems of force measurements and weighing for the development of rockets and space vehicles is presented by Dr. W. A. Menzel in a NASA speech. Discussed are a micrometeoroid impact recorder; the use of gravity differences to stabilize spacecraft; flowmeter and pressure gauge calibration; thrust measurement; determination of take-off weight of a space vehicle, and of the weight of individual stages and component parts; determination of the center of gravity; calibration of tanks for filling; and control and measurement of fuel consumption. L.S.

N65-29417*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE RANGER VII MISSION
H. M. Schurmeier, R. L. Heacock, and B. P. Miller (RCA) 1964 36 p
(Contract NAS7-100)
(NASA-CR-58981) CFSTI: HC $2.00/MF $0.50 CSCL 22B

An analysis of the Ranger VII launch vehicle system and spacecraft system before and during its lunar picture-taking mission is given. The historical aspect of the Ranger spacecraft system concept is first considered. This is followed by brief discussions of Ranger Block III, launch problems, Ranger spacecraft, television camera subsystem, the space flight operations ground complex, the Ranger VII flight, and the Ranger VII mission results. N.E.A.

N65-29472*# National Aeronautics and Space Administrstion. Ames Research Center, Moffett Field, Calif.
EVALUATION OF PILOT'S ABILITY TO STABILIZE A FLEXIBLE LAUNCH VEHICLE DURING FIRST-STAGE BOOST
Gordon H. Hardy, James V. West, Robert W. Gunderson, and Charles O. Jones [1964] 59 p refs Presented at AIAA Astrodyn. Guidance and Control Conf., Calif. Univ., 24–26 Aug. 1964
(NASA-TM-X-51929) CFSTI: HC $3.00/MF $0.50 CSCL 22C

A preliminary manual control system for the S-IC, or first, stage of the Saturn V launch vehicle was designed and evaluated. With the exception of fuel sloshing dynamics (for which the data were not available), a complete fixed-base simulation was used. The results indicate that satisfactory manual control is possible. Author

N65-29583# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASYMPTOTICALLY STABLE STEADY-STATE ROTATIONS OF A SATELLITE
V. A. Sarychev 25 May 1965 17 p refs Transl. into ENGLISH from Russian
(FTD-MT-65-129; AD-615860)

The rotation of a satellite whose center of mass moves along a circular orbit is investigated. The equations of motion are given taking into account gravitational moments, and the steady-state solutions are determined by a system of algebraic equations. The region of stability of these solutions are graphed. A system of algebraic equations determining the static solutions is also given with the generalized forces considered, and a special and generalized solution is shown. Conclusions on the analysis of conditions of stability are drawn. Equations of motion of a satellite on an elliptic orbit without controlling moments, and on a circular orbit with unequal moments of inertia are also investigated. It was determined that the solutions correspond to different cases of coincidence of the principal central axes of inertia of the body with the axes of the orbital system of coordinates. C.T.C.

N65-29596*# RAND Corp., Santa Monica, Calif.
FUEL REQUIREMENTS FOR ALTITUDE CONTROL OF LARGE ORBITING APERTURES
R. H. Frick Jun. 1965 47 p refs
(Contract NASr-21)
(NASA-CR-63996; RM-4610-NASA) CFSTI: HC $2.00/MF $0.50 CSCL 22B

If a large aperture could be established in a synchronous orbit, it could be used as a highly directional antenna. In order to use these directional properties, a precise attitude control system is necessary. This Memorandum analyzes the fuel requirements of the attitude control motors in order to achieve certain variations in orientation. The results indicate that the requirments for holding a steady attitude in either pitch or roll are reasonably modest, while maintenance of high-frequency oscillations of the vehicle may result in excessive fuel expenditure. The feasibility of any such system depends on the size of the orbiting vehicle and the attitude variations required for its mission. Author

N65-29682*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
MODIFIED LAUNCH VEHICLE (MLV) SATURN V IMPROVEMENT STUDY Composite Summary Report
2 Jul. 1965 74 p refs
(NASA-TM-X-53252) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Saturn V improvement Studies are conducted. The purpose of the studies was to determine the requirements for modifying the S-IC, S-II, and S-IVB stages. Maximum use was to be made of existing facilities, hardware, and technology for configurations that could be obtained in the 1970–1975 time frame. Presented are the summary results of the detailed definition, design, performance, and resource studies conducted by the contractors under eight study contracts for the Modified Launch Vehicle (MLV) Saturn V configurations. Major system and structural revisions to the stages along with the performance and schedules for each vehicle are included. The evaluation of the problems associated with the design, development, and operation of the MLV-Saturn V vehicles

disclosed that these vehicles are a practical means of uprating the Saturn V vehicle. No unsurmountable problems were uncovered. Detailed design and manufacturing procedures are within present technology and tooling capability. M.R.W.

N65-29685*# National Aeronautics and Space Administration, Washington, D. C.
CENTAUR (AC-6) TEST FLIGHT
30 Jul. 1965 22 p
(NASA News Release-65-235) Available from the Scientific and Technical Information Division CSCL 22D

The vehicle development flight, designated Atlas–Centaur 6 (AC-6), will be a full-scale simulated mission to determine Centaur's capability to inject a Surveyor spacecraft on a lunar-transfer trajectory. AC-6 will test several new development features of the Centaur vehicle, including a Centaur propellant utilization system to provide maximum use of available propellants; an up-rate Atlas propulsion system—used on other Atlas launches but not with Centaur—which develops about 389 000 pounds of booster thrust; and a smaller volume liquid oxygen tank in the Centaur stage which matches the volume of the liquid hydrogen tank more accurately than earlier vehicles and thus provides more payload capability. A discussion of technical background and flight history, launch vehicle, payload configuration, and instrumentation and tracking is presented. A sequential description of the mission is given. N.E.A.

N65-29765 General Dynamics/Astronautics, San Diego, Calif.
INVESTIGATION OF SEPARABLE RE-ENTRY ESCAPE SYSTEM CONCEPTS AND SEPARATION TECHNIQUES
Christopher J. Cohan *In* Space and Flight Equipment Assoc. Proc. of 2nd Natl. Flight Safety, Survival and Personal Equipment Symp. [1964] p 157–194 refs (See N65-29750 18-05)

This report summarizes the results of an analysis of escape system separation techniques from a maximum heating re-entry trajectory. Four escape capsule concepts applicable to a lifting type flight vehicle were considered. These are (1) a separable-nose ballistic body; (2) a separable-nose lifting body; (3) a pod capsule; (4) a turn-around capsule. The objective of the study was to determine the applicability of these capsules and various thermal protection schemes to providing escape capability from the maximum heating point of a typical lifting re-entry trajectory. The compatibility of escape techniques developed at the maximum heating point with providing escape capability throughout the complete mission profile was also investigated. It was determined that all concepts except the turn-around capsule could provide escape capability throughout the mission. The structural design aspects of the separation interface and applicable disconnect techniques are discussed. The complete presentation of the results of this investigation are contained in FDL-TDR-65-161. Author

N65-29783*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
RELATIVE ADVANTAGES OF SMALL AND OBSERVATORY TYPE SATELLITES
George H. Ludwig May 1965 26 p Presented at the COSPAR Symp., Buenos Aires, 13–19 May 1965
(NASA-TM-X-55243; X-611-65-189) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Both the relatively small Explorer and the large Orbiting Observatory classes of scientific satellite have advantages which need to be considered carefully when a new space experiment is to be performed. The small satellite offers greater choice in tailoring the orbit to the experiments. The smaller size simplifies the electrical, magnetic, and radiated interference problem, since fewer operating components are involved. It provides greater ease in testing and scheduling, and permits a shorter pre-launch lead time. The larger observatory permits the conduct of more complex or larger numbers of related experiments for the more detailed study of the co-relationships between the numerous space phenomena. Since it is less highly integrated, standard experiment/spacecraft interfaces can be defined to simplify the experiment design and integration problems. The larger size permits the use of higher capacity and more flexible data systems and more precise active orientation systems. Operational efficiency is higher, since the data from a large number of experiments can be recorded and processed simultaneously. It is concluded that both types should continue to be used to meet the varied requirements of the space sciences program. Author

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N65-29800*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ENVIRONMENTAL TEST PROGRAM AND SYSTEM EVALUATION OF THE SYNCOM COMMUNICATION SATELLITE
Joseph F. Stockel Mar. 1965 46 p
(NASA-TM-X-55246; X-326-65-98) CFSTI: HC $2.00/MF $0.50 CSCL 22B

A plan is presented for defining test requirements, methods, and general procedures to be followed in testing the prototype and flight models of the Syncom communications satellite. Environmental tests and detailed system performance tests were conducted to evaluate the spacecraft design and operation, with the spacecraft subjected to the system performance tests before and after each environmental exposure. A test sequence is given for each prototype and flight model tested. Motor firing tests were conducted to collect vibration and thermal data by firing the motor aboard an operating spacecraft in a simulated environment. A test was also performed to determine the effects of an explosion of a nitrogen tank on board Syncom I spacecraft; results show that the spacecraft would be silenced. A test log and performance review is given for all systems evaluated. M.R.W.

N65-29809*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
RELATIVE ADVANTAGES OF SMALL AND OBSERVATORY TYPE SATELLITES
George H. Ludwig May 1965 26 p
(NASA-TM-X-55261; X-611-65-189) CFSTI: HC $2.00/MF $0.50 CSCL 22B

Both small and large observatory satellites have advantages which must be considered when a new space experiment is to be performed. The small satellite offers greater choice in tailoring the orbit to the experiment. The orbital, orientation, telemetry, and operational needs of an experiment are not compromised as much because fewer experiments are involved. The smaller size simplifies the electrical, magnetic, and radiated interference problem; and provides greater ease in testing and scheduling, and permits a shorter pre-launch lead time. The larger satellite permits more complex or larger numbers of related experiments for the more detailed study of space phenomena. Since it is less highly integrated, standard spacecraft interfaces can be defined to simplify the experiment design and integration problems. The larger size permits higher capacity and more flexible data systems, and more precise active orientation systems. Operational efficiency is higher because data from many experiments can be recorded and processed simultaneously. R.N.A.

N65-29819*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE NIMBUS I METEOROLOGICAL SATELLITE—GEOPHYSICAL OBSERVATIONS FROM A NEW PERSPECTIVE

William Nordberg May 1965 35 p refs Presented at the COSPAR 6th Intern. Space Sci. Symp., Buenos Aires, 13–19 May 1965
(NASA-TM-X-55266; X-651-65-196) CSCL 22B

The Nimbus I meteorological satellite which was launched into a nearly polar, sunsynchronous orbit and was fully earth oriented carried a set of very high resolution television cameras, a directly transmitting television camera of lesser resolution and a High Resolution Infrared Radiometer. The observations of detailed cloud features during daytime, the direct transmission of such observations to local weather station via an Automatic Picture Transmission system and the measurement and pictorial presentation of earth, water and cloud temperatures from orbital altitudes at nighttime with the infrared radiometer have provided geophysical and meteorological measurements from a truly global perspective. Pictorial maps of cloud cover and of cloud top heights were obtained during nighttime permitting a three-dimensional analysis of the global cloud structure and inferences regarding the dynamics of weather fronts, severe storms, atmospheric circulation cells, etc. Radiation patterns observed over terrain in cloudless conditions indicate the temperatures of the soil and permit inferences, in certain cases, of soil conditions such as moisture, vegetation, mineral composition, etc. Author

N65-29849*# General Dynamics/Astronautics, San Diego, Calif.
FLIGHT DYNAMICS AND CONTROL ANALYSIS OF THE CENTAUR VEHICLE (ATLAS/CENTAUR AC-5)
K. C. Bonine Jan. 1965 255 p refs
(Contract NAS3-3232)
(NASA-CR-54466; GD/A-DDE65-004) CFSTI: HC $6.00/MF $1.50 CSCL 22D

The stability and control analyses for Centaur stage flight of the Atlas Centaur AC-5 configuration are presented. The analyses were performed to verify the ability of the flight control system to stabilize short period oscillations about the vehicle center of gravity during powered phase flight, longer period oscillations resulting from use of an integral term in the steering equation during powered phase flight, and attitude excursions during coast phase flight. The Atlas Centaur separation, Centaur ignition, steering enable, cutoff transients, and Centaur payload separation were also analyzed. Results show that the flight control system provides adequate stability and control throughout all flight phases and that the separation system is also adequate. R.N.A.

N65-29899*# National Aeronautics and Space Administration, Washington, D. C.
NASA TO LAUNCH THIRD ORBITING SOLAR OBSERVATORY
15 Aug. 1965 30 p
(NASA News Release-65-261) CSCL 22B

A NASA press kit and a fact sheet on the Orbiting Solar Observatory (OSO-C) was released. Technical information is also given on the OSO program, and the program objectives are outlined. The OSO-C satellite will carry out pointed experiments involving an ultraviolet scanning monochromator and a solar spectrometer; and wheel experiments involving a thermal radiation emissivity detector, earth albedo telescopes, direction radiometer telescopes, a celestial gamma-ray detector, a solar X-ray detector, a cosmic ray charge spectrum detector, and a solar X-ray telescope. Descriptive diagrams of wheel and control systems are given. Innovations on OSO-C include an improved ground command system, a torque coil to augment the nitrogen gas jet system, and an improved roll aspect measuring device. Characteristic data for the three stages of the Delta Launch rocket used to launch the OSO-C satellite are also presented. L.S.

N65-30188*# National Aeronautics and Space Administration, Washington, D. C.
GEMINI 5
12 Aug. 1965 94 p
(NASA News Release-65-262) Available from the Scientific and Technical Information Division CSCL 22B

Background information and a general news release for the Gemini 5 space mission are presented in a press kit. A summary of the flight plan; food, clothing, and body waste disposal requirements; and the Gemini spacecraft and launch vehicle are discussed. The planned space experiments are detailed, and the manned space flight tracking network is discussed. M.W.R.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-29157# Allied Research Associates, Inc., Concord, Mass.
PHOTOELASTIC INVESTIGATION OF STRESSES IN A PENETRATED HEMISPHERE Final Report
Harold Hamilton and Herbert Becker 21 Dec. 1965 36 p ref
(Contract NObs-90363)
(ARA-F-271-5; AD-615415)

A photoelastic study was made to determine the influence of seat conditions on the stress distribution in a representative plastic window of a bathyscaph pressure vessel. Friction measurements were made for comparison of materials and surface finishes. Two-dimensional tests established the general character of the stress distributions in the window, and three-dimensional tests revealed the stresses in a scale model of the prototype. It was found that the three-dimensional stress distribution in the region of the inner face of a plastic window, when tested in a steel sphere and loaded under external pressure, was similar to stresses in the two-dimensional models in that same region. The ratio of maximum stress to applied pressure was found to be 0.85 in the three-dimensional window model, which would also pertain to the prototype. Author

N65-29158# Allied Research Associates, Inc., Concord, Mass.
STRESSES IN REINFORCED, PERFORATED RECTANGULAR PLATES LOADED BY TRANSVERSE PRESSURE Final Report
Ralph Papirno and Herbert Becker Dec. 1964 79 p refs
(Contract NObs-88508)
(ARA-F-239-4; AD-615480)

A combined theoretical and photoelastic investigation was conducted to develop optimum reinforcements for penetrations in submarine pressure bulkheads. Experimental results obtained on unreinforced holes in plates under biaxial bending showed good correlation with existing data for uniaxial bending from which stresses are determinable for any biaxial bending moment ratio. In addition, stresses were determined for various biaxial bending ratios on plates with apertures reinforced according to a procedure currently in use. In order to acquire this information it was necessary to develop a new photoelastic technique which is described in detail. This procedure was used successfully at room temperature to examine reinforcements on moment loaded plates. Problems arose in the application of the technique to pressure loaded plates.

Therefore, stress freezing was employed for these studies. However, the large deflections induced during these latter studies raised questions as to the accuracy of the data. As a consequence, further investigation appears indicated before design optimization procedures are achievable. This report contains complete details of the investigation together with recommendations for an approach which should yield reliable data for designing optimum reinforcements at apertures in pressurized bulkheads. Author

N65-29174*# Northrop Corp., Newbury Park, Calif.
DEVELOPMENT OF A RADIO-FREQUENCY TRANSPARENT ENERGY-ABSORBING STRUCTURAL ELEMENT
Ronald H. Smith Washington, NASA [1965] 97 p refs
(Contract NAS1-3906)
(NASA-CR-253) CFSTI: HC $4.00/MF $0.75 CSCL 13H

An experimental investigation has been conducted to develop highly efficient energy-absorbing structural elements from radio-frequency transparent materials. The materials were evaluated using two types of energy absorption processes; the fragmenting tube and the crushing of honeycomb and foamed materials. Plastic reinforced glass fabric tubes, employed in the fragmenting tube process, yielded specific energies of 28 400 and 12 300 ft-lb/lb for fabric orientation in the longitudinal and hoop directions respectively. The crushing of nylon-phenolic honeycomb yielded a value of specific energy of 14 400 ft-lb/lb for a 3/16 inch cell size, 9.0 lb/ft^3 density, and with a usable stroke of 80% of initial length. Radio frequency transmission losses were well within acceptable limits for the specified 100 to 2000 megacycle frequency range investigated. Author

N65-29192*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
RF TRANSPARENT, ENERGY ABSORBING STRUCTURAL ELEMENTS Monthly Progress Report No. 9, Feb. 1–Mar. 31, 1964
William M. Meyers [1964] 22 p Prepared for JPL
(Contracts NAS7-100; JPL-950564)
(NASA-CR-63951) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Attempts to analytically predict energy absorption values for various glass reinforced plastic honeycomb designs were unsuccessful. However, design curves were established using the results of static and dynamic tests, which serve the same function as an analytical solution. A plan is submitted for the next phase of the program which will include new data to take into account the effect of angular impact landings on smooth surfaces which are essentially frictionless. These data will be applicable to both flat and curved vehicle designs. The specific energy curves for various specimen designs will be revised and extended to include values for optimum designs having various cell sizes and densities. Specific energy absorption and crushing stress values will be calculated for all specimens tested. E.E.B.

N65-29272# Aerospace Corp., El Segundo, Calif. El Segundo Technical Operations.
STRESSES AND STRAINS IN MULTI-LAYER ANISOTROPIC HOLLOW CYLINDERS
Norman N. Au 30 Jun. 1965 59 p refs
(Contract AF 04(695)-469)
(SSD-TR-65-59; TDR-469(5560-30)-4; AD-466156)

Equations for elastic stresses and strains due to uniform internal and external pressures and an arbitrary radial temperature gradient are derived for a long, hollow, anisotropic, N-layer concentric circular cylinder in generalized plane strain. The anisotropic cylinder is made of materials having three mutually orthogonal planes of elastic symmetry, and the principal axes of anisotropy coincide with the principal axes of the cylinder. The derivation considers the composite cylinder to be made of materials that are layer-wise elastic, homogeneous, and anisotropic. The equations are written in such forms that they are readily applicable, with minor modifications, to the isotropic and monotropic cylinders. Two end conditions are treated: the cylinder with free ends, and the cylinder with a prescribed end force. Emphasis is placed on the analysis of practical configurations in which cylinders of anisotropic, monotropic, and isotropic materials are bonded concentrically in any order to one another. The important effects of anisotropy together with the errors that can result by assuming isotropy for an anisotropic material are discussed. The requirements on physical properties of materials for the purpose of assessing structural integrity of a given design are also delineated. Author

N65-29298*# Martin Co., Baltimore, Md.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF PRESSURIZED TOROIDAL SHELLS Final Report
P. F. Jordan Washington, NASA, Jul. 1965 66 p
(Contract NASw-913)
(NASA-CR-261) CFSTI: HC $3.00/MF $0.50 CSCL 20K

The behavior of a thin shell of revolution with a crown (example: torus) rather than a pole (example: sphere) is decisively determined by the shell mechanism at the crown. This fact permits an asymptotic analysis, which is so formulated that the solving functions become almost invariant with respect to the transition from the shell without internal pressure to the pressurized membrane. The transition range is discussed, in particular the transition to the membrane limit. Relations to previous formulations are given. Tests in which a 54-inch diameter torus shell was subjected to both pressurization and axial load led to excellent agreement, in general, with analytical predictions. Author

N65-29392*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE EFFECT OF MATERIAL PROPERTIES ON THRESHOLD PENETRATION
Richard H. Fish and James L. Summers [1964] 26 p refs Presented at the 7th Hypervelocity Impact Symp., Tampa, Fla., 17–19 Nov. 1964
(NASA-TM-X-54786) CFSTI: HC $2.00/MF $0.50 CSCL 11F

One criterion often selected to assess the hypervelocity impact resistance of space materials is that of the threshold condition for penetration. Such a criterion is applicable in determining the performance of many space-vehicle components, such as manned modules, pressurized cotainers, fuel tanks, etc. Accordingly, thin plates of a variety of metals were subjected to the impact of small aluminum spheres from relatively low speeds to velocities as high as 8.5 kilometers per second. The metals tested ranged in density from a magnesium–lithium alloy to a beryllium–copper alloy and were selected to have diverse mechanical and physical properties. Threshold penetration conditions were determined and details of the mode of failure, such as lip formation, spalling, and cracking were examined. Examination of the test data resulted in a possible explanation for the failure of the stainless-steel sensors on the Explorer XVI satellite to record expected meteoroid impacts. Author

N65-29410*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BUCKLING OF A CYLINDRICAL SHELL LOADED BY A PRE-TENSIONED FILAMENT WINDING

Martin M. Mikulas, Jr. and Manuel Stein [1964] 9 p ref
(NASA-TM-X-54745) CFSTI: HC $1.00/MF $0.50 CSCL 13M

An idealized model of a cylindrical shell loaded by pretensioned filament winding was studied to determine buckling strength. The material compressibility in the thickness direction is represented by many closely spaced independent radial springs located between the shell and the filaments. For the case of insulation secured to the shell by filament winding, the springs represent the thickness compressibility of the insulation. For the case of filaments wrapped directly on the shell, the springs represent some effective thickness compressibility of the shell and filaments. A simple closed form solution is obtained for the model. Results are plotted in dimensionless form so that the buckling load can be obtained directly for wide ranges of the geometrical and stiffness parameters of the model. Results show that the loaded shells can have much higher classical buckling strengths than if the loading were replaced by an equivalent external lateral pressure. Material compressibility in the thickness direction plays a major role in the mechanism through which these structures buckle. R.N.A.

N65-29476*# IIT Research Inst., Chicago, Ill.
APPLICATIONS OF PRESTRESSED SEGMENTED BRITTLE MATERIALS IN AEROSPACE STRUCTURES
Paul C. Hermann 4 Aug. 1964 2 p
(Contract NASr-65(04))
(NASA-CR-58431) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Research continued on prestressed segmented brittle material applications to aerospace structures. Efforts were directed towards resolving the segment interface problem by attempting to achieve perfect contact between segments, and by determining methods to predict equivalent contact areas and their subsequent equivalent moments of inertia for imperfect contact between segments. Glass segments with the required flatness could not be obtained and efforts to slice up glass blocks into matching segments produced unsatisfactory surfaces. Precision gauge blocks of TiC are being tried. Experiments on various size segmented columns are being designed to measure the size effect on effective moment of inertia and the effective cross sectional area. Work is in progress to design tests to compare with the theory of prestressed monolithic brittle members. R.N.A.

N65-29488*# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
STRESS ANALYSIS OF CRACKS
Paul C. Paris and George C. Sih Jun. 1964 154 p refs Presented at the 67th Ann. Meeting of the Am. Soc. for Testing and Mater., Chicago, 21–26 Jun. 1964
(Grant NsG-410)
(NASA-CR-58751) CFSTI: HC $5.00/MF $1.00 CSCL 20K

A general survey of the results of elastic stress analysis of cracked bodies is the basic objective of this work. The stress-intensity-factor method of representing results is compared with other similar methods. All three modes of crack surface displacements are considered, as well as specialized results applicable to plate and shell bending. Results for various media (e.g. anisotropic, viscoelastic or non-homogeneous) are contrasted with the analysis of homogeneous isotropic media. The accuracy of the representation of the crack tip stress fields by stress-intensity-factor methods is discussed pointing out some limitations of applicability. Methods of estimating and approximate analysis for stress-intensity-factors in complicated practical circumstances are also discussed. Author

N65-29495*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF PRESSURE ENVIRONMENT ON THE DAMPING OF VIBRATING STRUCTURES
David G. Stephens and Maurice A. Scavullo [1964] 22 p refs Presented at 34th Symp. on Shock, Vibration, and Assoc. Environments, Monterey, Calif., 13–15 Oct. 1964
(NASA-TM-X-54725) CFSTI: HC $1.00/MF $0.50 CSCL 20K

An investigation was conducted to determine the mechanism of the air damping exhibited by rigid bodies of different shapes oscillating in a pressure environment. Circular and rectangular panels, as well as a sphere and cylinder, were attached to cantilever springs and the free decay of an induced oscillation measured at pressure levels from atmospheric to 4×10^{-2} torr. Data are presented to show the effect of pressure, vibratory amplitude, shape, and surface area on the air damping of the models. Results indicate that the magnitude of the air damping may greatly exceed the structural damping of the system. The air damping associated with the panels is directly proportional to the pressure and amplitude which is indicative of dissipative loads proportional to the dynamic pressure. Furthermore, the panel damping was found to be independent of shape, and a nonlinear function of the surface area. The sphere and cylinder exhibit viscous damping characteristics which are in good agreement with available theory. Author

N65-29548# Royal Aircraft Establishment, Farnborough (England).
A COMPARISON OF THE MEASURED AND PREDICTED FLUTTER CHARACTERISTICS OF A WING-AILERON-TAB MODEL
H. Hall London, Min. of Aviation, Aug. 1963 65 p refs Supersedes RAE-TN-STRUCT-338; ARC-25229; See X65-12583 (RAE-CP-715; RAE-TN-STRUCT-338; ARC-25229) HMSO: 12s

The paper presents results of wind tunnel flutter tests using a wing-aileron-tab model on which it was possible to represent any of the following tab systems: spring, geared, trim or servo. Prediction of the flutter characteristics has been made in the trim tab case using three sets of aerodynamic derivatives and fair agreement has been reached with the measured characteristics. A comparison has also been made of the measured characteristics with those predicted by the latest flutter criteria and possible modifications to the basic flutter frequency assumption used in deriving the criteria are discussed. One modification suggested is such that the basic flutter frequency is virtually dependent on the frequency in a single degree of freedom. The criterion form that results from such a single frequency approximation is investigated. Author

N65-29577# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
STRUCTURAL RESPONSE TO INTENSE ELECTROMAGNETIC RADIATION
R. C. Good, Jr. Jun. 1965 176 p refs
(Contract AF 49(638)-1030)
(R65SD25; AFOSR-65-0988; AD-616336)

An exploding wire apparatus has been used to study conversion of electrical energy into strain energy in glass, plastic, and metal samples. The strain energy left permanent marks on the sample in the form of discoloration, weight loss, erosion, and surface cracks. For glass samples, the surface crazed to a depth of 10^{-3} cm. The theoretical derivation of an adapted thermoelastic stress relation predicts the dimensions of the cracks and the power levels required if the absorption coefficient is at least 10^{3} reciprocal centimeters. The resistance of the exploding wire was measured empirically, and a theoretical justification made of its variation. This study characterized the exploding wire by spectral, calorimetric, and photographic studies. Stress waves were generated in epoxy bars which showed

that impulses postulated to be produced during blow-off can be measured at points within the solid rather than on the surface. Author

N65-29586# Battelle Memorial Inst., Geneva (Switzerland).
METHODS FOR LOWER BOUNDS TO FREQUENCIES OF CONTINUOUS ELASTIC SYSTEMS
N.W. Bazley and D. W. Fox (Johns Hopkins Univ., Silver Spring, Md.) Wright-Patterson AFB, Ohio, ARL, Mar. 1965 76 p refs
(Contract AF 61(052)-709)
(ARL-65-46; AD-616340)

Several methods are developed for the calculation of rigorous lower bounds for the frequencies of continuous linear elastic systems in free vibration. The precedures are applied to obtain numerical bounds for problems arising in beam theory. Author

N65-29598*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
HEAT TRANSFER TO A GAS CONTAINING A CLOUD OF PARTICLES Semiannual Status Report No. 6
J. Andrew McAlister, Edward Y. H. Keng, and Clyde Orr, Jr. 30 Jul. 1965 32 p
(Grant NsG-273-62)
(NASA-CR-54441) CFSTI: HC $2.00/MF $0.50 CSCL 20M

The basic radiation equations were solved to describe the radiant heat transfer from a black, cylindrical enclosure uniformly radiating to a black, evenly dispersed particle cloud contained within. Back thermal radiation and radiation scattering were considered negligible. The solution was presented graphically in generalized form with all variables being dimensionless quantities, and comparisons with experimental data were shown. Equations were also presented for calculating the radiation absorbed by a particle cloud within unheated segments of the enclosure adjacent to the radiating element. A brief description of particle deagglomeration and cloud transmissivity studies was included. Author

N65-29604# Royal Aircraft Establishment, Farnborough (England).
A VIBRATION FREQUENCY CONTROL SYSTEM FOR "RESONANCE FOLLOWING" WHICH MAINTAINS A PRESELECTED PHASE ANGLE BETWEEN THE EXCITATION FORCE AND THE DISPLACEMENT OF A STRUCTURE
C. W. Skingle London, Min. of Aviation, Mar. 1962 8 p refs
(RAE-TN-STRUCT-310)

A control system is described for the excitation of a structure on or near a selected resonance, including overtone modes, utilizing the phase angle between the force and displacement to control the excitation frequency. This system was designed to follow changes in the resonant frequency of a structure due to changes in structural characteristics. These changes may, for example, be due to kinetic heating or fatigue of a structure during a test. Author

N65-29609# Royal Aircraft Establishment, Farnborough (England).
THEORETICAL EVALUATION AND MINIMUM WEIGHT DESIGN OF THERMAL PROTECTION
E. C. Capey Mar. 1965 23 p refs
(RAE-TR-65041)

The behaviour of thermally protected structures subjected to kinetic heating is analyzed, and figures of merit derived to define the effectiveness of the thermal protection. The configuration analyzed consists of a structure represented thermally as a flat plate, covered with a layer or layers of insulating material, plus in some cases a cooling system employing circulating liquid. Optimum configurations are indicated by maximizing the figures of merit for a given weight of thermal protection. Author

N65-29638# Royal Aircraft Establishment, Farnborough (England).
A MULTIPLE FREQUENCY RESONANCE TESTING TECHNIQUE FOR STRUCTURES WITH RAPIDLY CHANGING DYNAMIC CHARACTERISTICS
F. J. Hawkins, C. W. Skingle, and G. A. Taylor Mar. 1965 28 p ref
(RAE-TR-65067)

Methods of following, simultaneously, changes in several natural frequencies of a transiently heated structure are discussed. One method, using a multiplying technique, is discussed in some detail and the results of tests to prove the technique are presented. Author

N65-29656*# Georgia Inst. of Tech., Atlanta.
AXISYMMETRIC RESPONSE OF CONICAL SHELLS TO BLAST LOAD
James Ting-Shun Wang Aug. 1964 32 p refs
(Grant NsG-571)
(NASA-CR-58733) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The dynamic response of thin elastic conical shells subject to blast load is formulated according to membrane theory. The solutions are obtained by the technique of separation of variables with Poisson's ratio neglected. Author

N65-29679*# Northrop Space Labs., Huntsville, Ala.
RESEARCH ON THE STRUCTURAL PERFORMANCE OF LARGE ROCKET BOOSTER SUBJECTED TO LONGITUDINAL EXCITATIONS
J. Hill, J. Kincaid, C. Pearson, and D. Ulbrich 19 Mar. 1965 95 p refs *Its* Res. and Anal. Sect. Tech. Memo. No. 66
(Contract NAS8-11255)
(NASA-CR-64076; E-20-78) CFSTI: HC $3.00/MF $0.75 CSCL 20K

Response of a circular cylindrical shell subjected to a gimballed periodically varying end thrust is studied theoretically. This work represents an initial step in analyzing the dynamic structural behavior of a large rocket booster during powered flight. The theoretical model developed in this investigation retains the features that the thrust was time varying and gimballed for directional control. Galerkin's procedure is applied in obtaining shell equations of motion. The influence of damping and initial conditions on the dynamic stability of a uniform free-free beam under a gimballed thrust of periodically varying magnitude are also analyzed. J.M.D.

N65-29692# Utah Research and Development Co., Inc., Salt Lake City.
THEORETICAL AND EXPERIMENTAL STUDY OF LOW-VELOCITY PENETRATION PHENOMENA: PHASES III, IV, AND V Semiannual Report
Nov. 1964 47 p refs
(Contract DA-19-129-AMC-150(X); ARPA Order 267)
(AD-467443)

The tensor formulation of the stress-strain relationships involved in finite time-dependent deformation of a solid has been changed from that previously reported. The new mathematical model is described along with a discussion of the applicable mathematics. The computer code developed to calculate the flow field in impact has been modified to eliminate propagated error in the time dimension. A system for high

speed photographic analysis of deformation of wires and rods is described. Data from rod-to-rod impact are analyzed to determine the energies involved in metal deformation. Average energy per unit deformation is found to decrease with increasing impact velocity. Author

N65-29698# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING THE BEHAVIOR OF SHELLS AND PLATES UPON IMPACT
A. S. Vol'mir and I. G. Kil'dibekov 11 May 1965 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Mashinostro. (Moscow), No. 7, 1964 p 26–30
(FTD-TT-65-443/1; AD-615871)

Compiled are nonlinear dynamic equations of the theory of elasticity of thin shells and plates with consideration of inertia forces, corresponding to displacements in the center surface. To the number of such problems are included, for example, the problem of the behavior of cylindrical shells at longitudinal impact. Introduced is a dynamic function of stresses in the center surface of shell and flat panel. For a shell of arbitrary outline was obtained a system of three equations relative to the function of stresses, bending function, and tangent stress in center surface. Discussed are special cases of a circular cylindrical shell and flat panel. In static variant is given a system of differential equations which changes over into an ordinary system of equations of nonlinear theory of shells. When the nonlinear members are thrown away and in the assumption that initial bending is absent, it is possible to obtain basic equations of dynamic linear theory. Author

N65-29787# Rensselaer Polytechnic Inst., Troy, N. Y.
FATIGUE FAILURE OF SURFACE FILMS Technical Report, 1 Aug. 1964–31 Oct. 1964
Y. C. Hsu and F. F. Ling Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1965 47 p refs
(Contract AF 33(657)-10058)
(AFML-TR-64-397; AD-616291)

For the purpose of correlating the maximum shear stress at the film-substrate interface to the fatigue life of the film, the quasi-stationary nature of the shear stress at the interface of a surface layer and the substrate as induced by a load moving at a constant speed along the surface of the layer is investigated. The substrate occupies the half-space. Solutions in integral form, based on the two-dimensional theory of elasticity, are obtained for the shear stress at the interface for the cases of: (a) layer material at subsonic speed; (b) layer material at transonic speed; and (c) layer material at supersonic speed. For all cases, the base material is subsonic. Subsonic and supersonic refer to speeds less than speed of propagation of shear wave and greater than the speed of propagation of dilatational wave, respectively. Author

N65-29851# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
NON-LINEAR NUMERICAL ANALYSIS OF AXISYMMETRICALLY LOADED ARBITRARY SHELLS OF REVOLUTION
Philip Mason, Robert Rung, Jacob Rosenbaum, and Rein Ebrus Jul. 1964 29 p refs
(ADR-02-11-64.3)

The non-linear interaction between the meridional stress resultant and rotation is significant in discontinuity regions of highly strained thin shell structures. The non-linear equilibrium equations may be linearized for any given axisymmetric load condition by inserting the meridional stress resultant, obtained from membrane analysis, where it appears in product terms. Forward integration is used to solve the set of linear differential equations which are derived from the linear strain-displacement relations and the linearized equilibrium equations. By introducing artificial boundaries within the shell, the extent of integration is limited to conform with current numerical techniques. Influence coefficients for segments are computed, and standard methods of matrix structural analysis are used to obtain stress resultants and displacements at the segment interfaces. These are used as initial values for a final numerical integration to determine stresses and displacements throughout the shell. The differences between stresses calculated by means of linear and non-linear equations are graphically represented from the results of the analysis of a typical pressure vessel support joint. The well-known reduction of peak stresses in the vessel wall is verified but the bending stress in the support skirt is greater with the non-linear analysis. Author

N65-29852# Boeing Scientific Research Labs., Seattle, Wash.
ON A FREE FLOATING SHIP IN WAVES
W. D. Kim Jun. 1965 47 p refs *Its* Flight Sci. Lab. Rept. No. 100
(DI-82-0446)

The oscillatory forces on a free floating ship of spherical or ellipsoidal hull at zero forward speed in a head sea are evaluated for the modes of surge, heave, and pitch. The potential boundary-value problem consists of (1) the determination of the radiation potential which is due to the forced oscillation of a floating ship in a calm sea, and (2) the determination of the diffraction potential which is due to the scattering of oncoming waves on a ship fixed in the equilibrium position. Upon knowing the values of the radiation potential over the immersed surface of the ship, the hydrodynamic forces arising from the impingement of oncoming waves are evaluated using the Haskind relation. Thus, the dependencies of added mass, added moment of inertia, and damping coefficients on the frequency of the forced oscillation as well as on the frequency of the oncoming wave are shown. Finally, the equation of motion governing the oscillation of the freely floating ship is obtained through the synthesis of hydrodynamic forces in the radiation and diffraction problems. Author

N65-29853# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE ANALYSIS OF CYLINDRICAL SHELLS STRENGTHENED BY STRINGERS AND RIBS
V. A. Zarutskii [1964] 2 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 1, no. 5, 1965 p 127–128

Criteria are presented for the application of the theory of structurally orthotropic shells to the analysis of infinite circular closed cylindrical shells strengthened by stringers and ribs, and subjected to the effect of internal pressure. An approximate method is used to determine the stress strain state of reinforced shells taking account of the discrete disposition of the ribs. R.N.A.

N65-29866# General American Transportation Corp., Niles, Ill. MRD Div.
ANALYSIS OF FREE-FIELD DATA IN A HALF-SPACE UNDER DYNAMIC LOADS Final Report, 15 Oct. 1962–1 Jan. 1965
Kirtland AFB, N. Mex., AF Weapons Lab., Apr. 1965 109 p refs
(Contract AF 29(601)-5552)
(WL-TR-64-143; AD-615906)

Exact analytic formulas are developed for obtaining wavefront stress and stress-gradient values in elastic and viscoelastic half-spaces subject to dynamic surface loading. These

exact wavefront stress values are used along with the results of a double-precision computer code in the display of stress profiles for the elastic half-space problem. Viscoelastic and elastic attenuation formulas are derived. Attenuation contours are plotted. Author

N65-29895# RAND Corp., Santa Monica, Calif.
A NOTE ON SANDWICH SHELL THEORY
T. C. Fan 14 Apr. 1965 21 p refs
(P-3121; AD-615945)

This paper describes the probable development of classical theories employed in the stability analysis of sandwich shells. The validity of existing theories is scrutinized. New evidence collected in recent structural tests is used to propose some improvements in current sandwich shell theory. Author

N65-29922# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
A STUDY OF ROUGH-TERRAIN-INDUCED STRUCTURAL LANDING LOADS. PHASE III: SIMULATED LANDINGS OF AN OV-1 AIRCRAFT OVER ROUGH TERRAIN AND COMPARISON OF EXPERIMENTAL LOADS WITH THEORETICAL PREDICTIONS
Fort Eustis, Va., Army Avi. Mater. Labs., May 1965 130 p refs
(Contract DA-177-TC-735)
(USAAML-TR-65-5; Phase III; AD-616734)

This report describes the third phase of a project directed toward the establishment of aircraft design criteria for rough terrain landing operations. The report presents the results of moving drop tests in which an OV-1 main landing gear was made to traverse simulated terrain irregularities of various sizes and shapes during landing impact. Test results for several cases are compared with the results of dynamic loads calculations performed on a digital computer. Recommendations for improvement of the analysis are made based on this comparison. Author

N65-29923# Army Materials Research Agency, Watertown, Mass.
THE ROTATIONALLY SYMMETRIC MOTION OF A SMALL-ANGLE TRUNCATED CONICAL SHELL DUE TO A CONSTANT VELOCITY PRESSURE FRONT. PART II: NUMERICAL RESULTS
Joseph I. Bluhm and Donald M. Neal Apr. 1965 33 p
(AMRA-TR-65-09)

A thin truncated conical shell is analyzed for the initial transient response due to the passage of a pressure front of constant velocity and amplitude. The principle of virtual work is applied to a segment of the shell, between two adjacent generatrices, treated as a beam on an elastic foundation. The ends of the shell are considered to be simply supported. First, the natural or free modes of vibration are approximated using an eight-term series of functions each satisfying the boundary condition. Then the resulting modes are used in conjunction with time-dependent coefficients to formulate the forced response. Author

N65-29936# Martin Co., Baltimore, Md.
AXISYMMETRIC BENDING AND BUCKLING OF THIN SHELLS OF REVOLUTION
Gaylen A. Thurston Apr. 1964 84 p refs
(SR-0530-64-2)

The numerical solution of Reissner's finite-deflection equations for shells of revolution programmed for computer computation is discussed. The program was written primarily as a research tool to investigate the effect of initial imperfections in shape on shell buckling; however, it is not limited to buckling applications. It can be applied to any tank, dome, or bellows problem which can be approximated by a thin shell of revolution under axisymmetric loads. The analysis is limited to shells that have continuous curvature. For practical problems where the structure can be represented as a series of ring-reinforced shells, the solution should be extended to generate influence coefficients for input into a general structures matrix solution. E.E.B.

N65-29945# Naval Postgraduate School, Monterey, Calif.
THERMAL STRESS AND BOWING OF A TUBE SUBJECTED TO A TEMPERATURE DISTRIBUTION INDEPENDENT OF TUBE LENGTH
William Perry Haworth (M.S. Thesis) 1964 54 p refs

The theorem of least work was used to investigate the stress pattern and bowing, i.e., uniform curvature, of an initially straight thin tube subjected to a steady temperature distribution independent of the longitudinal coordinate of the tube. Simple equations were developed for stress, strain, and bowing. They show that if the thermal strain is expressed as a Fourier series, the tangential stress is small and is a function of the first harmonic only, the axial stress is a function only of the second and higher harmonics, and the bowing is a function only of the first harmonic. Author

N65-29961*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
STRUCTURAL BEHAVIOR AND BUCKLING STRENGTH OF HONEYCOMB SANDWICH CYLINDERS SUBJECTED TO BENDING
James P. Peterson and James Kent Anderson Washington NASA, Aug. 1965 29 p refs
(NASA-TN-D-2926) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Results of buckling tests on three honeycomb sandwich cylinders loaded in bending are presented and discussed. In addition, analytical studies are made on (1) the influence of the core and bonding material in enhancing the stiffness of composite sandwich plates like those of the walls of the test cylinders and on (2) plastic buckling of sandwich cylinders in compression. Results of the two studies are compared with observed behavior of the test cylinders. The bending stiffness of the test cylinders correlated well with predicted behavior. Buckling of the test cylinders occurred at lower loads than predicted by theory by about the same margin that would be suggested by an extrapolation of the results of buckling tests on conventional thin-wall cylinders. Author

N65-29968# Naval Postgraduate School, Monterey, Calif.
THERMAL STRESS ANALYSIS OF PRESSURE VESSELS WITH CYLINDRICAL SKIRT SUPPORTS
James P. McManus (M.S. Thesis) 1964 107 p refs

A method is described for determination of stresses near the circumferential junction of shell, head, and skirt of a pressure vessel subjected to mechanical and thermal loadings. Considerable latitude is permitted for variation in geometrical, mechanical, and loading characteristics; however, it is presumed that there is complete symmetry about the axis of the vessel. A digital computer program is appended to facilitate solution of the problem. Author

N65-29977# California Univ., Livermore. Lawrence Radiation Lab.
DYNAMIC STRUCTURAL ANALYSIS WITH SHORT TIME HISTORY
George L. Henderson 20 Apr. 1964 34 p refs Submitted for Publication
(Contract W-7405-ENG-48)
(UCRL-7794)

Equations have been developed for use in the design of structures sustaining all types of superimposed dynamic loads with short time histories. Explosion-type blast waves in an air medium are used to illustrate the procedure for solution of the equations. Particular solutions for blast waves are formulated graphically with the aid of digital computers. In the past, attention has been concentrated almost exclusively on peak values of pressure, and few attempts have been made to incorporate the shock wave's entire time history. Since a structure's dynamic response depends not only on peak values of pressure, but also upon the characteristics and histories of all related waves, it is necessary to have an adequate description of the shock wave before an accurate loading condition can be predicted. For a designer to proceed with an analysis of a structure under any loading condition, he must have a full understanding of the nature of the real structural responses before attempting simplifications in order to facilitate procedure. To provide this understanding in the area of dynamic loads with short time history is the object of this paper. Author

N65-29996# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

SABOR I: A FORTRAN PROGRAM FOR THE LINEAR ELASTIC ANALYSIS OF THIN SHELLS OF REVOLUTION UNDER AXISYMMETRIC LOADING BY USING THE MATRIX DISPLACEMENT METHOD

John H. Percy, Dhirendra R. Navaratna, and Stanley Klein Apr. 1965 105 p refs
(Contract AF 04(694)-427)
(ASRL-TR-121-5; AD-616735)

A Fortran II program for the matrix displacement finite-element method of analysis of thin shells of revolution subjected to *axisymmetric* loading is presented. Included are descriptions of the idealization and the static analysis of the structure, calculations of the element stiffness matrix, the element mass matrix, and the stress resultants and couples. A complete Fortran listing of SABOR I is given together with the program flow diagram and input and output instructions. The complete results for two example problems are listed to enable the user to check the adaptation of the computer program to his facility. Author

N65-30031# Mitre Corp., Bedford, Mass.

DYNAMIC STRESSES IN AN ELASTIC CYLINDRICAL LINING OF ARBITRARY THICKNESS IN AN ELASTIC MEDIUM

C. C. Mow and W. L. Mc Cabe Apr. 1965 55 p refs
(Contract AF 33(600)-39852)
(ESD-TR-65-112; SR-57; AD-615388)

Dynamic stresses in a thick-wall elastic cylinder in an infinite elastic medium during passage of plane, compressional waves are investigated. Dynamic stresses around the cylinder in the elastic medium are also determined. Numerical results for two different cylinders with ratios of outer radius to inner radius ranging from 1.05 to 1.20 are presented in a dimensionless form. It is shown that increasing thickness does not, in general, reduce stresses in the cylinder; in addition, dynamic stresses at certain wave numbers are higher than the corresponding static value. Author

N65-30069# Frost Engineering Development Corp., Denver, Colo.

RESPONSE OF A LINEAR DAMPED DYNAMIC SYSTEM TO SELECTED ACCELERATION INPUTS Summary Technical Report, Apr.–Jun. 1963

Stanley Barrett and Peter R. Payne Wright-Patterson AFB, Ohio. AMRL, Apr. 1965 47 p refs *Its* Tech. Rept. 194–10
(Contract AF 33(657)-9514)
(AMRL-TR-65-40; AD-616643)

The general theory is developed for the response of a single degree of freedom dynamic system to an arbitrary acceleration forcing function. Closed-form solutions are obtained for a variety of discrete pulse shapes using the method of Laplace transforms and the form of the solutions indicated for oscillatory inputs and semi-infinite ramps, in terms of complex Fourier series. A comparison of base and mass excitation of the system is included. In previously published work on this subject, analytical solutions are in general only given for undamped systems; an exception is the response to a sine-wave, which appears in many standard texts. The dynamic analysis of the human body usually considers models involving damping, so that in this area there is a definite need for the extensions given. Author

N65-30083# Royal Aircraft Establishment, Farnborough (England).

VECTORIAL ANALYSIS OF FLIGHT FLUTTER TEST RESULTS

E. G. Broadbent and E. Violet Hartley London, Min. of Supply, Feb. 1958 52 p ref
(RAE-TN-STRUCT-233)

A binary flexure-torsion analysis has been made to check theoretically a method for the prediction of flutter which depends on plotting vectorially the amplitudes of response relative to the exciting force and extracting the relevant damping rate. The results of this calculation are given in the form of graphs both of the vector plots themselves and of the estimated damping rate against forward speed. The estimated damping rates are compared with calculated values. The method has the advantage that in a flight flutter test damping can be estimated from continuous excitation records; the method is an extension of the Kennedy and Pancu technique used in ground resonance testing. Author

N65-30096# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

EFFECT OF A SHOCK WAVE ON A FLOATING RIGID-PLASTIC BOX STRUCTURE

R. B. Testa and H. H. Bleich Apr. 1965 46 p refs
(Contract Nonr-266(86))
(TR-34; AD-617768)

A method is presented to determine the deformations of a rigid-plastic box structure which floats on the surface of a fluid and contains an internal, elastically supported mass. The situation is a simple representation of a surface vessel in which plastic deformations resulting from an underwater shock greatly exceed the elastic deformations. The method is applied to the case of symmetric initial velocity distribution, excluding buoyancy effects. Numerical solutions for two simple initial velocities are obtained for the complete range of a significant parameter. The results indicate that when substantial plastic deformations occur, the solution consists of many phases, in each of which a certain group of plastic hinges is active. If the number of plastic hinges (and degrees of freedom) becomes large, the number of phases in a solution may become excessively large, and the conditions separating them are very complicated. Author

N65-30102# Utah Research and Development Co., Inc., Salt Lake City.

THEORETICAL AND EXPERIMENTAL STUDY OF LOW VELOCITY PENETRATION PHENOMENA Semiannual Report, Phases III, IV and V

May 1965 28 p refs
(Contract DA-19-129-AMC-150(X); ARPA Order 267)
(AD-617892)

A study of the strength of materials under large deformation has been conducted. The sample to be tested was in the form of a thin disk and was crushed between a fixed and a moving anvil. Velocities ranging from 10^{-3} to 10^{4} cm/sec were obtained by driving the anvil either by a testing machine or by a compressed-air gun. A simplified analysis of the problem is given, and the assumptions used are discussed and compared with the experimental data. The relationship between internal energy of the material and deformation is found to be $U = \tau \ln (z_0/z)$ where U is energy per unit mass, z_0 and z are initial and final thickness of the disk and τ is a constant, the "strength" of the material. Variations in τ are discussed in terms of strain-rate effects and strain-hardening effects. The materials tested were copper, 99.99 per cent pure aluminum, 6061-T4 and -T6 aluminum, Nylon, Lexan, Teflon, polyethylene and polypropylene. Author

N65-30113# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
ASYMPTOTIC ANALYSIS OF THE AXISYMMETRIC VIBRATIONS OF SHELLS
Edward W. Ross, Jr. Apr. 1965 32 p refs
(AMRA-TR-65-08; AD-616604)

An asymptotic analysis is carried out for the equations of axisymmetric vibration of thin shells, somewhat analogous to the procedure by which geometrical optics is obtained from electromagnetic theory. It is found that two types of asymptotic solutions are obtained, roughly classifiable as high-frequency membrane solutions and bending solutions. Two explicit representations of these solutions are obtained, one for the shallow region of a shell, and the other for the non-shallow region. A number of interesting conclusions emerge from the analysis. Author

N65-30138# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
THREE-DIMENSIONAL STRESS CONCENTRATION AROUND A CYLINDRICAL HOLE IN A SEMI-INFINITE ELASTIC BODY
Carl K. Youngdahl (Argonne Natl. Lab.) and Eli Sternberg May 1965 50 p refs
(Contract Nonr-220(58))
(TR-2; AD-617570)

This paper contains a three-dimensional solution, exact within classical elastostatics, for the stresses and deformations arising in a halfspace with a semi-infinite transverse cylindrical hole, if the body—at infinite distances from its cylindrical boundary—is subjected to an arbitrary uniform plane field of stress parallel to the bounding plane. The solution is in integral form and is deduced with the aid of Papkovich stress functions by an especially adapted, unconventional, integral-transform technique. Numerical results for the non-vanishing stresses along the boundary of the hole and for the normal displacement at the plane boundary, corresponding to several values of Poisson's ratio, are also included. These results exhibit the three-dimensional stress boundary layer that emerges near the edges of the hole in the analogous problem for a plate of finite thickness, as the ratio of the plate-thickness to the diameter of the hole grows beyond bounds. The results obtained illustrate the limitations inherent in the two-dimensional plane-strain treatment of the spatial plane problem. Author

N65-30142# California Univ., Berkeley. Inst. of Engineering Research.
SYMMETRIC DEFORMATIONS OF VISCOELASTIC-PLASTIC CYLINDERS
M. J. Crochet Mar. 1965 38 p refs
(Contract Nonr-222(81))
(AM-65-1; AD-617136)

This paper, in the main, contains a general solution for a viscoelastic–plastic hollow circular cylinder under internal pressure and in the state of plane strain. The medium is assumed to be isotropic and homogeneous. Solutions for both loading and unloading from a viscoelastic–plastic state are considered and numerical results are obtained for the specific case of an incompressible cylinder under a step pressure. Also discussed briefly is the torsion of a viscoelastic–plastic cylinder, the solution of which is again illustrated by a numerical example. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-29255# Naval Postgraduate School, Monterey, Calif.
HEAT TRANSFER AND FLOW FRICTION CHARACTERISTICS OF PERFORATED NICKEL PLATE-FIN TYPE HEAT TRANSFER SURFACES
J. M. Bannon, C. H. Piersall, Jr., and P. F. Pucci 30 Jun. 1965 87 p refs
(USNPGS-TR-52; AD-467052)

Experimental results for the convective heat transfer and flow friction characteristics of plate-fin type heat transfer surfaces are presented for eight surfaces. Six surfaces were fabricated of perforated nickel plate, one perforated nickel fins with solid nickel plate splitters and one of solid nickel plate. The heat transfer data were obtained by the transient technique and includes the effect of longitudinal conduction. Author

N65-29258# Naval Ordnance Lab., White Oak, Md. Explosions Research Dept.
INITIATION OF EXPLOSIVES BY EXPLODING WIRES
Howard S. Leopold Jun. 1965 33 p refs
(NOLTR-65-1; AD-463360)

Silver, copper, and iron wires were investigated as possible bridgewire materials. The wires were exploded by a 1-microfarad capacitor charged to 2,000 Volts. Wire materials that give high peak powers are favorable for effecting detonation. Low boiling point, low heat of varporization metals such as silver and copper permit greater energy transfer to an explosive than high boiling point, high heat of vaporization metals such as iron. Author

N65-29266# Little (Arthur D.) Inc., Cambridge, Mass.
SOLID PROPELLANT IGNITION STUDIES First Quarterly Report, Apr.–Jun. 1965
W. R. Niessen and E. K. Bastress 15 Jul. 1965 22 p refs
(Contract AF 04(611)-10741)
(AFRPL-TR-65-136; AD-466661)

This report presents the status of a research program studying solid propellant ignition. The experimental program involves a study of ignition at high convective flux levels; of ignition in the presence of oxygen; and of ignition in a varying heat flux environment. The apparatus to be used in the study has been modified to reduce heat losses. Preliminary calibration has been completed. High flux levels have been

attained using carbon monoxide-oxygen mixtures. Hydrogen-oxygen mixtures were unsatisfactory because of the condensation of water vapor on the flux gauges. Effort during the next quarter will be directed at ignition testing at high flux levels.
Author

N65-29294*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
RADIATION GEOMETRY FACTOR BETWEEN THE EARTH AND A SATELLITE
Tommy C. Bannister Washington, NASA, Jul. 1965 32 p refs (NASA-TN-D-2750) CFSTI: HC $2.00/MF $0.50 CSCL 20M

In solving thermal problems of satellites, the geometry factors must be known. A brief discussion of geometry factors, an analytical expression, and computer procedure is given. Methods for computing these geometry factors from basic relations require lengthy computer programs with many inputs. A method was devised in the Space Thermodynamics Branch of the Research Projects Laboratory of MSFC for obtaining these factors for space thermal calculations from a subroutine similar to the common trigonometric subroutines. It requires only 600 octal locations. This is less than 10 percent of the total memory of the IBM 7094 Mod. II used by the Computation Laboratory. Maximum computer time required per factor obtained is .0015 seconds on the IBM 7094 Mod. II. This subroutine has been used for over two years without any apparent problems.
Author

N65-29300# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. Chemical Propulsion Information Agency.
PROCEEDINGS OF THE FIRST ICRPG COMBUSTION INSTABILITY CONFERENCE, VOLUME 1
Jan. 1965 498 p refs Conf. held at Orlando AFB, Fla., 16–20 Nov. 1964
(CPIA-68; AD-458060)

Studies on liquid, solid, and composite propellants are presented, concerning combustion mechanisms and instability. For individual titles see N65-29301–N65-29341.

N65-29314 Massachusetts Inst. of Tech., Cambridge.
MECHANISMS OF COMBUSTION INSTABILITY
Tau-Yi Toong, Richard F. Salant, John M. Stopford, and Griffin Y. Anderson *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 219–249 refs Presented at the 10th Intern. Symp. on Combust., Cambridge, Engl., 21 Aug. 1964 (See N65-29300 18-33)

Results of a study of the mechanisms involved in triggering, amplification, and suppression of acoustic waves due to the presence of flames are presented. Strong interactions between acoustic and flame oscillations can exist through flow oscillations. These interactions are due to energy transport between various oscillation modes through both linear and nonlinear couplings. The intensity of the interactions can be altered by varying flow velocity through an organ pipe. Under reduced-flow conditions, the linear coupling is eliminated and the flame exhibits periodic self-sustained oscillations. Supporting evidences are presented which show that onset of the self-sustained oscillations of diffusion flames is due to instability of travelling disturbance waves. Also, the effects of changes in flow field due to the presence of interacting burning and nonburning simulated fuel droplets on the oscillation characteristics are interpreted in terms of the postulated mechanism of boundary-layer instability. Under some conditions, oscillations can actually be stopped by placing nonburning cylinders near an oscillating flame.
E.E.B.

N65-29316 California Univ., Berkeley.
ROLE OF DETONATION IN COMBUSTION INSTABILITY
A. K. Oppenheim and A. J. Laderman *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 275–297 refs (See N65-29300 18-33)
(Grant NsG-702; AF-AFOSR 129-65)

After a short resume of some experimental observations in rocket engines that suggest the occurrence of detonation-like phenomena in the course of unstable operation, recent advances made in the understanding of the structure and development of detonation waves are described. The relationship between the two classes of problems are then delineated more specifically. On this basis future trends for studies that give best promise of elucidating upon the mechanism of the combustion instability process are outlined.
Author

N65-29317 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THERMAL RADIATION AS A TOOL IN ANALYZING UNSTABLE COMBUSTION
Marshall C. Burrows *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 301–309 (See N65-29300 18-33)

This paper describes the response of emitted thermal radiation to a high-frequency pressure oscillation with a rocket thrust chamber. Parameters controlling the radiation include the spectral distribution of the emitting species and the magnitude of the pressure and temperature variation within the chamber. Average emitted radiation within the spectral range from .3 to 3 microns is shown for H_2-O_2, N_2H_4-N_2O_4, hydrocarbon-oxygen, and composite solid-propellant flames. The response of emitted radiation to high-frequency pressure oscillations is shown for various wavelengths and optical depths. The H_2-O_2 flame is nearly transparent in the visible wavelength range, and hence this radiation has the highest response to a given pressure oscillation. Hydrocarbon-oxygen and solid-propellant flame radiation responds only to the temperature change associated with a given pressure oscillation and hence with this type of flame, the boundaries nearest the windows become important.
Author

N65-29318 Lockheed Propulsion Co., Redlands, Calif.
LINEAR PYROLYSIS RATE MEASUREMENTS OF PROPELLANT CONSTITUENTS
R. L. Coates *In* APL Proc of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 313–318 refs (See N65-29300 18-33)

The design and construction of a porous plate apparatus for the measurement of linear pyrolysis rates of solid propellant constituents and propellant oxidizers are discussed. Ammonium chloride was selected for the calibration of the device because a considerable amount of sublimination rate data are available. The data obtained are given; however, the reducibility of the data was not good. With ammonium perchlorate the data were more reproducible than that obtained with ammonium chloride. Data for AP and GRS rubber are also given and compared with previous measurements.
E.E.B.

N65-29320 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
SPECTROGRAPHIC MEASUREMENTS OF COMPOSITE PROPELLANT FLAME ZONE STRUCTURE
Louis A. Povinelli *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 331–333 (See N65-29300 18-33)

An experimental approach to the problem of flame structure based on flame radiation measurements is presented. The approach used was to burn propellant strands backlighted with

a mercury light source and to simultaneously record the spectra of flame gases and mercury light. The cutoff of the mercury light indicates the location of the propellant surface on the recording photographic plate. Comparison of the spectral radiation of the propellant with an adjancent mercury line yields spatial resolution of the species resulting from oxidizer-binder reactions. The CN band head at 3883 Å and an adjacent mercury line were used for comparative analysis. It was concluded that CN emission begins slightly above the burning surface at a distance of 70 microns. Peak CN radiation occurred at less than 165 microns from the propellant surface. The propellants were strands of ammonium perchlorate and polybutadiene acrylic acid. The mean weight diameter of the oxidizer was 11 microns. Spectra obtained at pressure above atmospheric revealed a strong continuum which obscured the CN line to such an extent that meaningful measurements could not be made. E.E.B.

N65-29321 Sheffield Univ. (England).
PROGRESS OF SOLID PROPELLANT COMBUSTION RESEARCH AT SHEFFIELD UNIVERSITY, 1964
J. Swithenbank *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 337–341 refs Sponsored by Min. of Aviation (See N65-29300 18-33)

The chemical behavior of the gas-phase induction zone and explosion zone of a solid double-base rocket propellant were analyzed theoretically through the investigation of 16 reversible chemical reactions involving 12 species and 4 irreversible reactions. Results were in qualitative agreement with published experimental data. Also, three aspects of combustion instability are considered: (1) the effect of electric fields on the combustion of solid propellants; (2) the acoustic properties of double-base propellants; and (3) the vortex generation in solid propellant rockets. Each of these subjects is considered. It is observed that complex internal ballistics caused by high amplitude acoustic waves are not readily amenable to exact treatment. It is suggested that nozzle flow straighteners or resonance rods of cruciform geometry should attenuate the vortices and thus increase the nonlinear damping. Increased attention should be given to nonlinear gain. E.E.B.

N65-29322 Aerojet-General Corp., Sacramento, Calif.
MICROSCOPIC DETERMINATION OF PROPELLANT COMBUSTION SURFACE TEMPERATURES
J. L. Mc Gurk *In* APL Proc. of 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 345–359 refs (See N65-29300 18-33)

Microscopic studies are conducted on solid propellant thin sections microtomed from the surface of extinguished propellants. Analysis with polarized light of crystallographic changes caused by polymorphic inversion in oxidizer crystals at the burned surface permits the determination of a surface temperature profile. The crystallographic mechanism of ammonium perchlorate thermal degradation is interpreted and extends the literature data by giving direct observation of the mosaic unit, which frequently occurs as a series of twin lamella. Interpretation of the twins indicates that in some cases the mosaic units apparently existed in the cubic phase while others were in the orthorhombic phase so that the two phases coexisted over a 50 micron time-depth zone below the advancing combustion surface. Author

N65-29323 Naval Ordnance Test Station, China Lake, Calif.
SURFACE CHARACTERISTICS OF QUENCHED SAMPLES OF COMPOSITE-ALUMINUM PROPELLANTS
J. E. Crump *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 361–365 (See N65-29300 18-33)

The quenched surface characteristics of a series of aluminized composite propellants in which the composition was systematically varied was studied. Also, a few propellants being used in development programs were examined to determine if there are any basic differences between the practical propellants and the systematic propellants examined. No basic differences were discovered. In the systematic series the basic composition was set at 75% solids and 25% binder. The following variables were examined: six aluminum perchlorate centrations; three aluminum particle sizes; and three ammonium perchlorate particle sizes. All propellants were burned at 100 psi and 400 psi. The most important features found were the extreme roughness of the surface and the accumulation of aluminum on the surface. Also, the surface irregularities become greater as the pressure is increased from 100 psi to 400 psi. Further, aluminum particle size and concentration appear to contribute significantly to the surface roughness. E.E.B.

N65-29324 Naval Ordnance Test Station, China Lake, Calif.
PHOTOGRAPHIC SURVEY OF ALUMINUM COMBUSTION IN SOLID PROPELLANTS
J. E. Crump *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 367–370 (See N65-29300 18-33)

Aluminum combustion in solid propellants was studied with high-speed photography. The physical arrangement consisted of a pressure vessel with fused quartz windows and a high-speed motion picture camera. The propellant sample size was varied according to the objective of the particular test; the sample was usually in the form of a slab 1/4-inch square and 1/8-inch thick. The sample was ignited on the top edge by a 10 mil hot wire. It was observed that regardless of the original particle size, the greatest number of aluminum agglomerates had a diameter of about 100 microns. This observation raises the question of what do aluminum particles of different sizes have in common which would explain this behavior? One characteristic the aluminum particles have in common is that the aluminum was contained originally in spaces between the ammonium perchlorate particles. This leads to the speculation that an aluminum agglomerate arises from the aluminum contained in one pocket of binder between ammonium perchlorate particles. If this is correct, the aluminum agglomerates size is determined by the amount of aluminum in the binder pocket. E.E.B.

N65-29325 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
BEHAVIOR OF LARGE ALUMINUM PARTICLES IN COMPOSITE PROPELLANTS
Louis A. Povinelli *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 373–376 (See N65-29300 18-33)

The factors which influence particle size in the combustion zone of aluminum composite propellants were investigated to determine particle size and if the particles are shed with any periodicity. The importance of both metal particle size and shedding frequency for both acoustic and nonacoustic instability is generally recognized. Also, nozzle design for two-phase flow is strongly dependent on particle size at the nozzle entrance. Three PBAA-AP-A1 propellants in which only the aluminum particle size was varied were used in the experiments. Results with shredded aluminum propellant revealed a mean number diameter of the combustion products of several microns, invariant with pressure. The original size appeared to have no significant influence on the product size. A small number of large particles were observed comparable to the size of the original additive. The size of these larger particles appeared to decrease with increasing pressure. The radiation output

revealed frequencies of 30 to 50 cps. At atmospheric pressure 3% of the particles were of size equal to or greater than the original. The number of these particles decreased to less than 1% at 500 psi. E.E.B.

N65-29326 Princeton Univ., N. J.
ENTROPY WAVE OBSERVATIONS IN OSCILLATORY COMBUSTION OF SOLID PROPELLANTS
R. H. Woodward Waesche, Joseph Wenograd, and Martin Summerfield *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jun. 1965 p 377–380 refs sponsored by AFOSR and ARPA (See N65-29300 18-33)

A search was made for entropy waves using photographic and radiometric techniques with a T-burner as the source of oscillating pressure. These experiments ranged from 75 to 1000 cps at pressures from 200 to 1000 psi. The propellant compositions included perchlorate composites and plastisol nitrocellulose types. The predicted entropy waves were not observed. The absence of these predicted waves implies that the simple flame zone models which were deduced from steady-state experiments to predict such waves may not be correct. Calculated flame temperature variations due to thermal lags in the solid phase were often quite large, although these variations could account for the absence of entropy waves only at the higher test frequencies. Since the experimental results do not confirm the theoretical predictions, further knowledge of steady-state combustion mechanisms is required before the dynamic coupling involved in combustion instability can be explained. E.E.B.

N65-29327 Naval Ordnance Test Station, China Lake, Calif.
RESULTS OF PRESSURE-COUPLED EXPERIMENTS AT THE NAVAL ORDNANCE TEST STATION
M. M. Ibiriou *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 383–386 (See N65-29300 18-33)

The pressure-coupling response function of several composite propellants was determined at pressure levels of 200, 400, and 800 psig and at 500 to 10000 cps by means of a double-end burner assembly. The propellants were basic ammonium perchlorate-polybutyl-acrylic acid formulations containing the following: (1) 1% copper chromite; (2) 1% lithium fluoride; (3) 1% of both additives; and (4) no additives. A fluorocarbon propellant was also studied at 800 psig. The variation of the response function versus frequency was taken as an indication of how prone the propellant was to pressure-coupled instability. The following effects were observed: (1) Copper chromite had great stabilizing influence at low frequencies but greatly extended the upper frequency limit at 200 and 400 psig. (2) Lithium fluoride lowered the upper frequency limit at low pressures but made the propellant more prone to instability. (3) The propellant containing both additives behaved very much the same as the propellant containing copper chromite. (4) The fluorocarbon exhibited the same characteristics as the lithium fluoride propellant although even more acutely. E.E.B.

N65-29328 Dartmouth Coll., Hanover, N. H.
RESULTS OF STANDING WAVE EXPERIMENTS
A. O. Converse *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 389–396 sponsored by the Ballistic Res. Labs. (See N65-29300 18-33)

The acoustic admittance of a burning surface can be calculated from oscillatory pressure measurements made at the piston end of a long tube. A technique is described which requires that the acoustic losses in the tube be known. Experimental difficulty was experienced in measuring the acoustic losses; however, it is considered that this can be overcome and that the technique is feasible. The behavior obtained is shown. The pressure rose to about 20 psi and remained steady during the combustion. E.E.B.

N65-29329 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
LOW FREQUENCY ACOUSTIC INSTABILITY STUDIES
S. F. Mathews *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 399–401 ref sponsored jointly with the Bur. of Naval Weapons (See N65-29300 18-33)

Low-frequency acoustic instability in composites and composite-modified double-base propellants was investigated. The objective of the investigation was to examine solid propellant systems in the low-frequency range where gas phase particle damping is least effective and to develop more efficient suppression techniques. Results indicate that accurate measurements of the acoustic response function can be obtained in the low-frequency range. A typical plot of exponential growth and decay rate curves is shown. The decay rates are not constant and are not a reliable measure of the motor acoustic losses. For this reason, the data are interpreted by measuring growth rate as a function of burning surface area. Acoustic response function measurements for a non-aluminized composite-modified double-base propellant are presented and compared to results with conventional double-base propellants. Preliminary results with a PBAA composite formulation indicate that the value of the response function at 220 cps is about 0.7 and 1.0 at 740 and 340 psi respectively. E.E.B.

N65-29330 Naval Ordnance Test Station, China Lake, Calif.
EVIDENCE FOR VELOCITY COUPLING
E. W. Price *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 403–408 refs (See N65-29300 18-33)

The features of observed combustion instability at frequencies below 1000 cps which suggest that velocity coupling is a major factor in this instability are reviewed. These factors are: (1) Velocity coupling in a particular acoustic mode tends to generate higher harmonics rather than amplify the mode in question. (2) The time constants of the combustion process satisfy the demanding requirements of velocity coupling. (3) The typically nonlinear initiation of axial-mode intermediate frequency instability indicates velocity coupling. (4) Velocity coupling is suggested by its prevalence with propellants which are shown to be relatively stable in pressure-coupled burners in the intermediate frequency instability range. (5) Velocity coupling is indicated by the effect of aluminum particle size on axial-mode instability. In summary, the observations pointing to the importance of velocity coupling in axial-mode instability at frequencies below 1000 cps leave little doubt as to the dominance of velocity coupling. This is a matter of major importance to future solid rocket motor development. E.E.B.

N65-29331 Aberdeen Proving Ground, Md. Ballistic Research Labs.
EXPERIMENTAL STUDY OF ACOUSTIC EROSIVITY EFFECTS ON SOLID PROPELLANT BURNING RATES
Leland A. Watermeier, William P. Aungst, and Richard C. Strittmater *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 413–423 refs (See N65-29300 18-33)

The burning rate variations were studied as functions of amplitude and frequency of gas oscillations parallel to the propellant burning surface. A standard, double-end burning T-motor was used as the basic apparatus with propellant test samples located at the velocity antinode of the self-excited

oscillating system. Results indicate the following: (1) The burning rate of the test sample is increased when it is located at the velocity antinode of the chamber. (2) The increase in the test sample burning rate is dependent upon the amplitude of the particle or velocity displacement parallel to the burning surface up to a certain value. (3) The burning rate tends to drop or decrease as the amplitude exceeds a certain value. (4) The wall temperature at the end of the chamber and at the longitudinal center of the chamber may be as much as 50° to 100° K apart. These conclusions are preliminary and may be altered as more data become available. E.E.B.

N65-29334 Stanford Research Inst., Menlo Park, Calif.
INFLUENCE OF PROPELLANT BURNING RATE ON THE INCIDENCE OF INTERMEDIATE FREQUENCY INSTABILITY
L. A. Dickinson, E. L. Capener, and R. J. Kier *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 455–457 (See N65-29300 18-33)
(Contract AF 49(638)-1367)

The relationship of propellant burning rate and composition to the incidence of finite amplitude axial wave instability was investigated for a wide range of propellant variables. Results indicated that for one family of high-energy ammonium perchlorate-based propellants the pressure level at which instability could be induced was proportional to the linear burning rate of the propellant. When the fast burning AP-based propellants were used, a point was reached at which instability could not be initiated; similarly the very much faster burning propellants based on KP and LiP could not be driven unstable. Also, slow burning propellants based on AN did not sustain unstable combustion. When the burning rate of a propellant was increased by using finely divided oxidizer the fast burning propellant was stable, but the slow burning one was highly unstable in the axial mode. It was concluded that: (1) Axial instability in the 100 to 1000 cps range can be sustained by typical state-of-the-art AP-based propellants. (2) The LiP and KP based propellants are either inherently stable or their characteristic combustion lag time is too short. (3) Studies indicate that the conventional binders do not materially influence the incidence of unstable burning. E.E.B.

N65-29335 Canadian Armament Research and Development Establishment, Valcartier (Quebec).
SOME FURTHER DATA ON NONLINEAR AXIAL-MODE INSTABILITY
A. K. Roberts and W. G. Brownlee *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 459–470 refs (See N65-29300 18-33)

Experiments were made to confirm and extend earlier data on axial combustion instability. The critical pressure is a function of propellant composition. Over the broad range of burning rates, higher critical pressures are associated with the faster propellants. This gross trend cannot be applied within a narrow burning rate range. For a given propellant, any single change in formulation which accelerates the burning rate tends to increase the critical pressure. At a given binder level the highest critical pressure is obtained when the aluminum level is such that the stable burning rate is a maximum. For a propellant with 10% aluminum, a reduction in the binder level from 25% to 20% by weight led to an increase in the critical pressure from 770 to 1575 psia. For a propellant with 27% binder and 17% aluminum, an increase in the critical pressure from 750 to about 1300 psia was obtained when 1% of copper chromate was added. Ferric oxide was not nearly as effective as copper chromite in promoting stability. A propellant containing 27% binder, 17% aluminum, and 1% copper chromite gave a critical pressure of about 1300 psia in an 8-inch diameter motor and 800 psia in the 17-inch diameter motor. E.E.B.

N65-29336 Naval Ordnance Test Station, China Lake, Calif.
EFFECT OF PROPELLANT VARIABLES AND PRESSURE ON AXIAL MODE INSTABILITY AT 300 CPS
H. B. Mathes *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 471–476 (See N65-29300 18-33)

A series of tests was conducted in a single burner configuration on two groups of propellants. The center-vented internal-burning charge configuration was selected in order to minimize the effect of varying acoustic radiation on the test results. One of the groups of propellants tested consisted of several commercial propellants for which rocket motor experience was available. All of these propellants exhibited severe form of instability, most of them doing so without pulsed initiation over the entire pressure range of 300 to 1500 psi. Two propellants that showed severe instability in high-pressure tests only when pulsed, exhibited such instability spontaneously in low pressure tests. The observed instability in low-loss burners suggests that stability of the same propellants in missile applications is due to high acoustic loss characteristics of the missile motor design and not to any positive stability of the combustion. The second group of propellants tested was chosen to study the effect of aluminum particle size on combustion stability. The behavior was qualitatively like that in the first series of tests, but a wide variation in behavior was observed as a function of aluminum particle size. E.E.B.

N65-29337 Utah Univ., Salt Lake City.
NONACOUSTIC, LOW-FREQUENCY COMBUSTION INSTABILITY OF SOLID PROPELLANTS
Norman W. Ryan *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 477–480 (See N65-29300 18-33)

Preliminary results are presented for nonacoustic, low-frequency combustion instability studies for solid propellants. Data for TF propellant under conditions at which F propellant burns stably show that chuffing occurred throughout the test at a frequency of 25 cps. Oscillations are evident on the crests of later chuffs. A similar test of TF propellant extending to larger values of combustor volume to vent area ratio concluded with burning at a steady mean pressure with low-frequency oscillations that finally died away. The terminal rapid-fire chuffing in all runs was due to uneven burn-out. The structure of a single chuff on an expanded time scale is shown. The growth of nonacoustic oscillations to the degree that burning was quenched is clearly illustrated. It is not possible to draw any general conclusions from this work. Possibly eventual conclusions will pertain quantitatively only to the burner used in the tests. Comparison of propellants with respect to the tendency toward nonacoustic instability should be possible. E.E.B.

N65-29338 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
LOW FREQUENCY NON-ACOUSTIC INSTABILITY STUDIES OF SOME COMPOSITE, MODIFIED DOUBLE-BASE (CMDB) PROPELLANTS
R. A. Yount *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 481–487 (See N65-29300 18-33)
(Contract NOw-64-0366)

Chuffing and low-frequency instability of CMDB propellants burning in a vented combustion bomb were investigated. The dependence of the time between chuffs at pressures near atmospheric was shown to be consistent with a theoretical relationship based on a model of condensed phase thermal initiation. Experimentally, the ratio of free volume to vent area was shown to have no effect on the induction time-bas

pressure relationship. This observation suggests that the induction time behavior after inception of chuffing is not dependent upon the ratio. It was also observed that the limiting pressure below which low-frequency instability occurred decreased as the free volume in the system increased. Further, the limiting pressure as determined from experimental motor firings using internally burning grains showed negligible dependence on the ratio. These experiments indicate that critical pressure limits for low frequency instability may not be applicable to larger systems if heat heat losses are radically different from those used in the experimental tests. E.E.B.

N65-29339 Aerojet-General Corp., Sacramento, Calif.
SOLID PROPELLANT BURNING RATE UNDER TRANSIENT HEATING AND EXTINGUISHMENT VIA "L* INSTABILITY"
B. E. Paul, N. S. Cohen, and L. Y. Fong *In* APL Proc. of the 1st ICRPG Combust. Instability Conf. Jan. 1965 p 491–506 refs (See N65-29300 18-33)

An expression has been derived describing the burning rate as a function of dp/dt as well as of p. This expression, earlier applied to transient ballistics problems such as the ignition interval, has recently been employed to analyze the initiation of solid propellant extinguishment. Permanence of extinguishment by L* instability is shown to be governed by ignition theory; it is hypothesized that the instability may really be successive instances of extinguishment followed by reignition It is suggested that this basic approach now be applied to oscillatory transients, such as acoustic instability, for purposes of computing the response function. The analysis should consider transient heating in general, i.e. due to velocity as well as pressure fluctuations, to note pressure and velocity coupling. Qualitative prediction of some experimental trends are encouraging. Author

N65-29340 Naval Ordnance Test Station, China Lake, Calif.
L* COMBUSTION INSTABILITY
E. W. Price *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. 1 Jan. 1965 p 507–512 refs (See N65-29300 18-33)

The low-frequency oscillatory behavior of solid propellant combustion was studied in a low L* (combustor volume to vent area ratio) burner which exhibits low frequency oscillations, chuffing, and quenching with most propellants. Typical results are illustrated which show the variation of oscillation frequency with mean pressure for several aluminum concentrations, oxidizer particle sizes, and aluminum particles sizes with two different binders. The investigation of the preferred frequency characteristics of propellant combustion was also investigated with two additional techniques. The first is the center-vented end burner which permits study of oscillatory behavior in the same range as the L* burner but in a pressure-coupled acoustic wave mode. Also, considerable promise is shown in results obtained by observing propellant sample burning in a window bomb equipped with modulated through-flow of inert gas. The modulated flow produces mild pressure oscillations which in turn produce combustion oscillations. These oscillations are monitored with a radiation transducer. The relative amplitude and the phase of the radiation oscillation is used to infer the nature of the coupling of the pressure oscillation with the combustion oscillation. E.E.B.

N65-29341 Dartmouth Coll., Hanover, N. H.
STABILITY OF COMPLETELY MIXED REACTORS
A. O. Converse *In* APL Proc. of the 1st ICRPG Combust. Instability Conf., Vol. I Jan. 1965 p 513–517 ref Sponsored by the Ballistic Res. Lab. (See N65-29300 18-33)

The influence of chemical reactions on pressure oscillations was investigated in a gas phase mixing tank reactor. This model combustion chamber is described. The reactant enters the chamber at a constant mass flow rate through a critical flow orifice. The exit flow depends on the condition within the chamber. The conservation equations and perturbation equations are given for the model. Also, the characteristic equation is presented as a polynominal related to the coefficients in the basic model. The solutions are shown for the time average mole fraction as a function of the dimensionless heat of reaction. Areas of stability and instability are discussed. E.E.B.

N65-29401*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
DEFINITION OF TEMPERATURE IN NONEQUILIBRIUM PROCESSES
Robert E. Mates and Roger C. Weatherston [1963] 16 p refs Submitted for Publication
(Contract NASr-109)
(NASA-CR-59116) CFSTI: HC $1.00/MF $0.50 CSCL 20M

This paper examines the validity of applying concepts of temperature as defined in classical thermodynamics to nonequilibrium processes. If the irreversibility in the process can be confined to heat flow between suitably defined subsystems, equilibrium thermodynamics can be applied by the definition of additional temperatures to characterize the subsystems. The classical thermodynamic temperature is defined as suggested by Clausius in terms of heat exchange between a reversible engine and energy reservoirs. It is shown that the above definition of classical thermodynamic temperature can sometimes be applied to a particular degree of freedom, such as vibration, even if it is not in equilibrium with the other degrees of freedom. However, it does not appear possible to extend this concept to a fluid with nonequilibrium chemical composition. To demonstrate this, the entropy rise in vibrational and chemical nonequilibrium processes is computed using the concept of multiple temperatures and compared with the classical result. The results agree for vibrational but not for chemical nonequilibrium. Author

N65-29418*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMMENTS ON ASME PAPER NO. 64-HT-12
R. J. Simoneau and R. C. Hendricks [1963] 7 p refs Submitted for Publication
(NASA-TM-X-51981) CFSTI: HC $1.00/MF $0.50 CSCL 20M

An attempt is made to resolve an apparent contradiction between two studies concerning the significance of temperature dependence of thermal and transport properties on Nusselt type correlations. The results of a carefully conducted experiment are presented and provide an independent set of local heat transfer data which are examined and compared with the other study. Neither of the approaches used in the separate studies answers the important question of the significance of property variations on heat transfer. The heat transfer system responds to changes in properties such that the system parameters reflect this response in a unique functional manner. Thus the common premise that thermal and transport property variations should be important remains unchanged and the contradiction in the role of transport properties remains unchanged. However, the existence of a contradiction indicates that measurements of the system parameters, while necessary, are not sufficient to determine the relationship of properties to turbulent heat transfer to a gas. R.N.A.

N65-29421*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT ON SURFACE THERMAL PROPERTIES OF CALIBRATED EXPOSURE TO MICROMETEOROID ENVIRONMENT

Herman Mark, Ralph D. Sommers, and Michael J. Mirtich Washington, NASA, 1965 30 p refs Presented at Second Aerospace Sciences Meeting, AIAA, New York, 25–27 Jan. 1965
(NASA-TM-X-52056) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An accurate procedure for reproducing the exposure of metal surfaces to impaction by micron-size particles at hypervelocities has been employed to expose targets of several materials. After degradation of surface optical properties in varying amounts due to such exposure, these targets were mounted on a simulated space vehicle that was then placed in a solar-space-environment chamber. In this chamber the pressure was maintained below 10^{-13} mm Hg, the black radiation sink of space was provided at 4.2° K, and the samples were placed in a beam-simulating solar radiation. The intensity of the beam was maintained at 1 solar constant, while reproducing reasonably well the spectral distribution of solar radiation in space. Values of normal solar absorptance, total hemispheric emittance, and equilibrium temperature for various materials were thus obtained as a function of exposure to simulated micrometeoroid impaction. Comparision of these data with actual satellite sample temperature histories will allow an alternate method of estimating micrometeoroid flux in space, without the limitations of momentum calibrated microphone data, or the need for hard-to-interpret penetration flux measurements. Author

N65-29439*# National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
TRANSIENT HEAT TRANSFER THROUGH A THIN CIRCULAR PIPE DUE TO UNSTEADY FLOW IN THE PIPE
Nisiki Hayasi and Kenji Inoue (Natl. Aerospace Lab.) [1964] 39 p refs Submitted for Publication
(NASA-TM-X-51939) CFSTI: HC $2.00/MF $0.50 CSCL 20M

An analysis of the transient heat transfer between a thin circular tube and the incompressible fluid moving through the tube is made for the case where the temperature of the inlet fluid is kept constant. Both radial conduction of heat in the wall and the heat loss at the outer surface of the cylinder are taken into consideration. It is shown to be especially easy to calculate temperature of both fluid and tube in the initial period by means of the attached figures. So far it is common to use the temperature of the wall calculated by the assumption that it is constant radially. It is shown that for the insulated tube in the initial period such temperature is equal to the temperature of the outer surface of the tube. The temperature of the inner surface of the tube may be appreciably different from such temperature even for the metallic tube. The difference is extremely large for the tube made from insulating material. Author

N65-29462*# Georgetown Univ., Washington, D. C. Dept. of Physics.
[STUDIES OF ABSORPTANCE AND EMITTANCE OF LUMINESCENT MATERIALS FOR CONTROLLING TEMPERATURE OF A SPACECRAFT SURFACE] Summary Technical Report
May 1964 74 p refs
(Grant NsG-428)
(NASA-CR-58215) CFSTI: HC $3.00/MF $0.75 CSCL 20M

Electroluminescent materials were investigated whose ratio of absorptance to emittance can be regulated to control the temperature of a spacecraft. Materials investigated include Sylvania nitelite, Sierraglow, a nickel–barium photovoltaic cell, a copper–lead sulfide photoconductive cell, and an n-type germanium sample with a doping concentration of 10^{16} donors per cc. A semiempirical theory explaining heat transfer in layers of homogeneous materials was developed. The feasibility of using electro-optical materials was investigated by simulating their effects with polaroids. R.N.A.

N65-29588# Rocketdyne, Canoga Park, Calif.
STEADY-STATE ROCKET COMBUSTION OF GASEOUS HYDROGEN AND LIQUID OXYGEN. PART I: EXPERIMENTAL INVESTIGATION
L. P. Combs and F. W. Hoehn Jun. 1964 65 p refs
(Contract AF 49(638)-817)
(RR-64-24; AD-615798)

Combustion of gaseous hydrogen and liquid oxygen has been studied experimentally under rocket conditions in an uncooled transparent-walled two-dimensional combustion chamber which simulated a 1-inch-wide diametrical section of a conventional cylindrical rocket combustor. Tests were made with three injector types using hydrogen chilled to simulate regenerative rocket engine injection temperatures. Photographic data were obtained which yielded considerable qualitative insight and quantitative information concerning the propellant combustion processes. Author

N65-29600# Royal Aircraft Establishment, Farnborough (England).
TWO-STAGE COMBUSTION OF EXPLOSIVE MIXTURES. THE INTENSITY OF THE FIRST AND SECOND STAGES OF IGNITION OF n-HEPTANE WITH AIR AT PRESSURES ABOVE ATMOSPHERIC
S. A. Yantovskii London, Min. of Aviation, Apr. 1965 19 p refs Transl. into ENGLISH from Kinetika i Kataliz (USSR), v. 5, no. 3, 1946 p 399–406
(RAE-LIB-TRANS-1105)

Experimental data are given relating to the intensity of the two stages of ignition of mixtures of n-heptane and air ($\alpha = 1$ and $\alpha = 0.8$). It has been shown that the intensity of the two stages is dependent upon the initial conditions and attains for a cold flame $I_{cf} = 1.04-1.2$, for a blue one $I_{bl\,f} = 1.3-2$, for a hot one $I_{hf} = 2.5-3$. The consumption of oxygen in these stages amounts to 2–6%, 14–40% and 50–70% respectively. The relatively high intensity of the first stage is noted (chain-heat flame) and the low intensity of the second stage (blue flame). A qualitative mechanism for two-stage ignition is put forward. As opposed to accelerating auto-catalytic ignition (chain or heat), two-stage ignition is characterized by the fact that the initiating process for the generation of energy of the burning mixture owing to the kinetic properties of the reaction is spontaneously retarded and, accelerating again, terminates with a second ignition. The mechanism of stage ignition has not been reliably determined hitherto and the kinetics of auto-retardation is a subject of study. Author

N65-29659# European Atomic Energy Community, Brussels (Belgium).
VISUALIZATION OF BUBBLE FORMATION AT ATMOSPHERIC PRESSURE AND RELATED MEASUREMENT OF THE WALL TEMPERATURE VARIATIONS
C. Bonnet, E. Macke, and R. Morin Apr. 1965 25 p ref
(EUR-1622.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

This report deals with a study on local wall temperature fluctuations due to the formation fo isolated bubbles in pool-boiling of water at atmospheric pressure. Those temperature fluctuations are made visible by the elongation of a luminous spot in the same optical plane as the phenomenon. The whole is filmed with a high speed camera. The set up of Ni-NiCr thermocouple for measuring rapid surface temperature variations is described. In agreement with the experimental results, a physical model of bubble formation based on a one-dimensional mathematical model is presented. Author

N65-29695# Naval Ordnance Test Station, China Lake, Calif.
TABLES OF BLACK-BODY RADIATION FUNCTIONS AND THEIR DERIVATIVES
E. J. Pisa Dec. 1964 101 p ref
(NAVWEPS-8646; NOTS-TP-3687; AD-616271)

This publication consists of a tabulation of the black-body radiation functions

$$\frac{W(\lambda,T)}{W_{max}(T)} \text{ and } \left(\frac{1}{W(\lambda,T)}\right)\left(\frac{\partial W(\lambda,T)}{\partial(\lambda T)}\right)$$

for rather extensive values of λT, as well as $W_{max}(T)$ for a wide range of temperatures. These tables were designed to facilitate the accurate determination of the black-body radiation functions $W(\lambda,T)$, $\frac{1}{W(\lambda,T)}\frac{\partial W(\lambda,T)}{\partial T}$, and $\frac{1}{W(\lambda,T)}\frac{\partial W(\lambda,T)}{\partial \lambda}$, and to allow for a means of rapidly calculating the fractional change of $W(\lambda,T)$ with λ and T, while reducing necessary interpolation to an acceptable minimum. Author

N65-29732*# National Aeronautics and Space Administration, Washington, D. C.
APPLYING THE TECHNIQUE OF INFRARED PHOTOGRAPHY TO WALL TEMPERATURE MEASUREMENTS IN ROCKET MOTORS
Jul. 1965 12 p Transl. into ENGLISH of the paper "Application de la Technique de Prises de Nues dans L'Infra-Rouge Aux Mesures de Temperature sur les Parois de Moteurs-Fusees" Presented at Centre Natl. d'Etudes Spatiales, Paris, 4–6 May 1964
(NASA-TT-F-9485) CFSTI: HC $1.00/MF $0.50 CSCL 20M

A description of photographic techniques using radiation-sensitive emulsions for temperature measurements, based on the relative degree of film darkening as determined by a Huet photoelectric microdensimeter. The theory of the relationship between film density and temperature is developed, followed by practical considerations on the type of film, camera, lens opening, exposure, and developer. A description of the experimental procedure for setting up reference curves as a standard for the temperature measurement follows. A specific example of measurements made on a particular rocket engine is given, from which the inherent advantages of this technique are evident, in that not only are temperature measurements for any particular small area possible, but they are quantitative as well as qualitative. Author

N65-29736*# National Aeronautics and Space Administration, Washington, D. C.
ERRORS IN TEMPERATURE MEASUREMENT ON THE SURFACE OF A SOLID BODY USING A THERMOCOUPLE WHEN HEATING AND COOLING FOLLOW AN ARBITRARY LAW [O PROGRESHNOSTI IZMERENIYA TEMPERATURY NA POVERKHNOSTI TRERDOGO TELA S POMOSHCH YU TERMOPARY PRI NAGREVANII I OKHLAZHDENII PO PROIZVOL'NOMU ZAKONU]
B. I. Makarov Jul. 1965 9 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 12, 1964 p 60–65
(NASA-TT-F-9496) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Equations are derived for determining errors in temperature measurement on the surface of a semi-infinite solid body by means of a semi-artificial thermocouple, when heating and cooling take place from some stationary temperature state in accordance with an arbitrary law. Author

N65-29739*# National Aeronautics and Space Administration, Washington, D. C.
DISSOCIATION KINETICS OF DIATOMIC MOLECULES IN THE ABSENCE OF VIBRATIONAL EQUILIBRIUM [O KINETIKE RASPADA DVUKHATOMNYKH MOLEKUL V OTSUTSTVIYE KOLEBATEL'NOGO RAVNOVESIYA]
S. I. Anisimov and G. S. Romanov Jul. 1965 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 7, no. 6, 1963 p 376–377
(NASA-TT-F-9500) CFSTI: HC $1.00/MF $0.50 CSCL 20M

To account for the dissociation of diatomic molecules under the variable temperature conditions typical of aerodynamic problems, the vibrational relaxation occurring in this case is approximately analyzed from the energy point of view at low temperatures, when the departure from vibrational equilibrium is only slight, and at high temperatures, when this departure becomes significant. The effect of vibrational relaxation vanishes when 1) the vibrational relaxation time shrinks to zero at low temperatures (equilibrium of vibrational degrees of freedom); 2) the temperature becomes very high. Author

N65-29829 General Motors Corp., Indianapolis, Ind. Allison Div.
FORCED-CONVECTION BOILING OF LIQUID METALS
Y. S. Tang and C. L. Walker *In its* Allison Res. and Eng. Quart. 1965 p 2–8 refs (See N65-29828 18-34)

The results of a boiling heat transfer study using potassium-mercury systems for the purpose of obtaining boiling characteristics of different compositions of potassium amalgams in a forced-convection system are presented. The data are required for determining the design of a thermal regenerator in a liquid metal electrochemical cell system. The experimental boiling liquid metal heat transfer loop is shown schematically, and the typical temperature profiles for the outer and inner tube walls are graphed. Also values of heat flux density for the net boiling region of the test section are plotted as a function of the wall superheat, and a summary of all experimental results (including net boiling and surface boiling heat transfer, exit quality and exit pressure data) are tabulated. Results are correlated, and the net boiling heat transfer data for potassium amalgams are compared with those for pure potassium. L.S.

N65-29863# Naval Postgraduate School, Monterey, Calif.
SOLUTION OF THE SINGLE BLOW PROBLEM WITH LONGITUDINAL CONDUCTION BY NUMERICAL INVERSION OF LAPLACE TRANSFORMS
Floyd E. Moreland (M.S. Thesis) 1964 75 p refs

A system of two partial differential equations represents the transient heat transfer behavior of compact heat exchanger surfaces when subjected to a step change in fluid temperature. A solution is presented for this system which includes the effects of longitudinal thermal heat conduction. Also presented are the solutions for the two limiting cases of zero and infinite longitudinal conduction. The numerical results indicate a significant decrease in computational time and an increase in accuracy of results. The revised curves of maximum slope of fluid temperature versus dimensionless heat transfer parameter should be of practical value in the evaluation of heat-transfer data obtained by transient testing of compact heat exchanger surfaces. An unusual combination of mathematical techniques is presented for the solution of a boundary value problem involving partial differential equations. The solution combines the application of Laplace transformation with a numerical technique for the inversion of Laplace transforms. This technique greatly expands the number of cases to which Laplace transforms may be successfully applied. Author

N65-29877# European Atomic Energy Community, Brussels (Belgium).
MEASUREMENT OF THE RESPONSE TIME OF THERMOCOUPLES IN LIQUID METAL CIRCUITS
F. Genet and B. Milliot Feb. 1965 43 p
(EUR-2281.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 60 Belg. Fr.

The characteristic time for different types of thermocouples has been measured in a flow of NaK alloy with the purpose of a possible application to the SORA reactor cooling loops. The measuring methods and the results obtained for 150 tests are presented in this report. These results are in good accordance with the same type of measurement performed with other fluids. Author

N65-29905# Aeronutronic, Newport Beach, Calif.
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Final Technical Report, 1 Oct. 1962–1 Mar. 1965
D. L. Hildenbrand, L. P. Theard, E. Murad, and F. Ju 1 Apr. 1965 75 p refs
(Contract AF 04(611)-8523; ARPA Order 348-62)
(AFRPL-TR-65-95; U-3068; AD-466785)

Torsion-effusion and mass spectrometric techniques were used to study various chemical equilibria involving beryllium species of interest. After the equilibrium species were definitely identified, standard thermodynamic methods were used to derive heats of formation. The data so obtained are summarized as follows:

	$\Delta Hf°_{298}$ kcal/mole		$\Delta Hf°_{298}$ kcal/mole
BeF (g)	-39.0 ± 2	Be_2O (g)	-8 ± 10
BeF_2 (g)	-187.0 ± 2	BeOH (g)	$> -25 \pm 10$
BeCl (g)	10 ± 5	$Be(OH)_2$ (g)	$> -156 \pm 10$
$BeCl_2$ (g)	-85 ± 3	Be (g)	77.3 ± 0.5

Author

N65-29946# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
PHYSIO-CHEMICAL FACTORS CONTRIBUTING TO THERMOELECTRIC PHENOMENA. PART I: THOMSON HEAT IN METALLIC SYSTEMS Final Report
D. V. Keller, Jr. and George M. Maxwell (Ph.D. Thesis) Jun. 1965 85 p refs
(Contract Nonr-669-(15))
(MET-969-665F, Pt I; AD-464868)

The fundamental concepts of the Thomson heat and the basic equations governing the heat flows associated with its generation are presented. From considerations of these equations, two new techniques for measuring the Thomson coefficient have been developed and examined experimentally. The two new techniques of studying a sample subjected to thermal and electrical gradients, included a non-equilibrium approach, in which the initial rate of change of temperature within the sample leads to a value of the Thomson coefficient, and a method based on equilibrium considerations. The latter leads to a very simple, straight-forward equation relating the Thomson coefficient to the change in equilibrium temperature associated with a reversal of current flow. An experimental apparatus was designed and utilized to examine the validity of the equations which were developed. The results obtained with these two new techniques agree reasonably well with the data obtained utilizing the standard technique and data extrapolated into this temperature range from previous work. Author

N65-29951*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CHARTS FOR EQUILIBRIUM AND FROZEN NOZZLE FLOWS OF CARBON DIOXIDE
George G. Mateer and Victor L. Peterson Washington, NASA, 1965 80 p refs
(NASA-SP-3019) CFSTI: HC $0.75/MF $0.75 CSCL 20M

Equilibrium and frozen nozzle-flow properties for carbon dioxide are presented in the form of charts. In the calculations for the frozen flows the flow was assumed to be in equilibrium to specified points in the nozzle where the chemistry was assumed to freeze instantly. Then, the flows were further expanded with the energy in molecular vibrations either frozen or in equilibrium with translational temperatures. Results are presented for total pressures ranging to 1000 atmospheres and total enthalpies ranging to 55 kilojoules per gram. The properties of temperature, pressure, density, velocity, dynamic pressure, Mach number, Reynolds number, molecular weight ratio, and species concentrations are presented in charts. Temperature, pressure ratio, and density ratio across normal shock waves in a nozzle are also included. Author

N65-30001# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF ELECTRICAL ANALOG METHOD TO SOLVING HEAT PRODUCTION PROBLEMS
I. S. Bobyr' 15 Jan. 1965 12 p refs Transl. into ENGLISH from Akad. Nauk Ukr. RSR, Inst. Mekhan. Napryazh. v Elementakh Turbomashin (Kiev), v. 2, 1962 p 162–170
(FTD-TT-64-753/1+2; AD-610371)

The method of electric modeling is applied to the solution of heat conductivity problems, based on the analogy between equations describing the stationary distribution of the temperature in a body and the potentials in an electric circuit. Methods of solving the equations of stationary and nonstationary temperature field in a nonhomogeneous body with sources of heat are given. Cases are also considered where there is a heat flow through the surface of a body; example problems are solved. C.T.C.

N65-30024# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
THE TOTAL HEMISPHERE EMITTANCE OF POLISHED AND OF OXIDIZED ALPHA PLUTONIUM Preliminary Report
R. H. Karlsson 7 Jul. 1965 11 p refs
(Contract AT(29-1)-1106)
(RFP-616) CFSTI: $1.00

The total hemispherical emittance of polished 99.66 w/o plutonium was determined to be 0.37 at 88.7° and 89.0°C. The emittance of a polished sample was measured after oxidation in a humid air atmosphere for 24, 66, and 168 hours. Emittances of 0.47, 0.54, and 0.70 were obtained. The apparatus was used to determine a total hemispherical emittance for candle soot of 0.96. Total errors were estimated to be less than ±3%. Author

N65-30025# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
ON THE STATISTICAL THEORY OF ELECTROMAGNETIC WAVES IN A FLUCTUATING MEDIUM (II). MATHEMATICAL BASIS OF THE ANALOGIES TO QUANTUM FIELD THEORY
K. Furutsu 7 Dec. 1964 46 p refs
(NBS-Monograph-79) GPO: $0.35

Many analogies to quantum field theory are inherent in the statistical theory of waves. This is due to the fact that basic equations exist in the latter theory which correspond closely to the fundamental equations of the former theory; i.e., to the commutation relations and the Heisenberg equation of motion. A probability density function of waves is introduced here which corresponds to the probability amplitude function in quantum mechanics. The boundary conditions at infinity for this probability density function are then found to be expressed in

the same form as the vacuum boundary conditions in field theory. The theory of the statistical Green's functions and their relationships to the expectation values of the physical variables is also extensively developed, using auxiliary external sources of the wave and of the fluctuating medium. It is found that there exists a one-to-one correspondence between the formalism of Green's functions presented here and that used in field theory. The above correspondence may be important for a further development of the statistical theory of waves, just as the advanced techniques of field theory have greatly influenced the development of thermodynamics (or statistical physics). Author

N65-30034# Marquardt Corp., Van Nuys, Calif. ASTRO Div.
TRANSPIRATION-FILM COOLING STUDY USING SPIRAL-WOUND RIBBON NOZZLE Second Quarterly Progress Report, Feb. 1–Apr. 30, 1965
J. E. Ahern and G. A. Yankura May 1965 52 p refs
(Contract AF 04(611)-10387)
(Rept.-25165; AD-615782)

The program consists of an analytical and experimental evaluation of the cooling capability of a nozzle design made by the spiral-wound-nozzle method. The following work was accomplished: (1) The analytical study was completed and all equations and methods of solution were selected. The digital computer program was completed and study cases are being run off on the IBM 7094 for evaluating the program characteristics. (2) The laboratory bench test work on evaluation of thermocouple techniques was completed. The single wire thermocouple approach was shown to be very satisfactory for measurement of the wall temperatures during transpiration cooling. (3) A preliminary blockage study run was completed which indicated that the grooved ribbon design offers promise of satisfactorily operating with coolants having contaminating particles, without catastrophic blockage. (4) Preliminary performances test data were obtained in the laboratory bench test program with aluminum and copper test samples. Author

N65-30037# Minnesota Univ., Minneapolis. Heat Transfer Lab.
PERFORMANCE CHARACTERISTICS OF A FULLY-DEVELOPED CONSTRICTED TRANSPIRATION-COOLED ARC Interim Technical Report, 1 Oct. 1963–1 May 1964
E. R. G. Eckert and J. E. Anderson Wright-Patterson AFB, Ohio, ARL, Apr. 1965 60 p refs Presented at the AGARD Specialist's Meeting on "ARC Heaters and MHD Accelerators for Aerodyn. Purposes", Rhode-Saint-Genèse, Belg., 21–23 Sep. 1964
(Contract AF 33(657)-7380)
(ARL-65-68; AD-615903)

A possible way to increase the peak enthalpy in a gas stream heated by a constricted arc is to make the constrictor wall porous and to inject some of the gas through this wall for cooling. The peak enthalpy of such an arc heater is compared with the peak enthalpy obtainable in a heater of identical geometry, but with a water-cooled constrictor wall. The comparison is made on the basis of a model which strongly simplifies the thermodynamic and transport properties of the gas. (Ratio of specific heat to thermal conductivity is constant, electrical conductivity is zero below a certain enthalpy h_e and increases linearly with enthalpy above, radiative power emitted per unit volume is zero below h_e and constant above.) The model predicts that the peak enthalpy at the center line of the exit cross-section of the transpiration-cooled constrictor can attain values more than an order of magnitude higher than in a water-cooled constrictor. Stability problems, difficulties at the electrodes, transition to turbulence and deviations from the assumed property variations will determine the upper limit of the peak enthalpy obtainable with this arc. These can only be determined by experiments. It is felt, however, that the present analysis indicates strong potentialities of a transpiration-cooled constricted arc. Author

N65-30087# General Dynamics/Astronautics, San Diego, Calif.
ULTRA-VIOLET DEGRADATION OF PASSIVE THERMAL CONTROL COATINGS
S. H. Bosch and D. T. Farrelly Dec. 1964 60 p refs
(GDA-ERR-AN-692)

Studies have been conducted to develop a passive thermal control coating for possible use on satellite and spacecraft surfaces. The primary goal was to find coatings with certain desired radiative properties that were stable in a space environment. The radiative property desired was a solar absorptance to emittance ratio of 0.30 or less. The simulated space environment of the project consisted of a clean 10^{-8} torr vacuum system and an ultra-violet mercury arc light source. Zinc oxide and zinc sulfide pigments with potassium silicate or a methyl silicone polymer as the binder were found to be the most stable coatings. With zinc oxide chosen as the best pigment further studies were conducted to determine the effect of formulation and preparation on the stability of the coating. The conclusions are that a zinc oxide coating with either potassium silicate or the methyl silicone polymer as the binder can achieve adequate passive thermal control for a limited time of two to six months. Author

N65-30111# RAND Corp., Santa Monica, Calif.
THE ROLE OF MELTING AND VAPORIZATION IN HYPERVELOCITY IMPACT
R. L. Bjork and A. E. Olshaker May 1965 32 p refs
(Contract AT 49(638)-700; Proj. RAND)
(RM-3490-PR; AD-617549)

The thermodynamics associated with the flow processes in hypervelocity cratering is discussed. Qualitative, graphical arguments are presented to show that previously proposed thermal-impact theories considerably overestimate the transference of energy into heating. The release temperatures and phases as a function of shock strength are summarized for nine metals, and calculations were carried out and results tabulated for 19 target materials which were impacted by iron and aluminum projectiles. It was found that the fraction of maximum shock internal energy remaining in the target on release is approximately constant, and that the heating effects must be considered in any theoretical prediction of an impact crater. At lower impact velocities this heating modifies the material strength, and at high impact velocities it creates a melted region in the target with greater dimensions than the crater size predicted on the basis of hydrodynamic flow only. C.T.C.

N65-30128# Georgia Inst. of Tech., Atlanta.
INVESTIGATIONS OF THE EFFECT OF ACOUSTIC VIBRATIONS ON CONVECTIVE HEAT TRANSFER Final Report
Thomas W. Jackson, Kenneth R. Purdy, Henry G. Keith, and Robert S. Rudland Wright-Patterson AFB, Ohio, ARL, May 1965 108 p refs
(Contract AF 33(616)-8396)
(ARL-65-97; AD-618140)

This report presents the experimental and analytical results obtained for the heat transfer coefficients in an isothermal tube which had an unheated starting length. The experimental apparatus used in the investigations was a 10 foot long heated section of 3.86 inch I.D. copper tubing with an inlet supply duct length of 28.22 feet. The heated section was designed to give local values of the heat transfer coefficient as well

as overall values. Data on heat transfer coefficients for Reynolds numbers from approximately 10,000 to 65,000 are presented for conditions of no-sound (without resonant acoustic vibrations) and for conditions of a resonant frequency in the tube of approximately 90 cps. For turbulent flow the effect of the resonant sound field is to reduce the heat transfer coefficients. A half-wave length periodic effect on the local heat transfer coefficient was noted. The local values of the turbulent heat transfer coefficients are correlated in relation to the no-sound values as a function of $U_o{}^2/Uc_o$, where U_o is the maximum sound particle velocity, U is the mean through flow velocity and c_o is the speed of sound. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-29281# Oxford Corp., Buffalo, N. Y.
IMPROVED AIRPORT GUIDANCE SIGNS Final Report
13 Nov. 1964 54 p *Its* Rept. -6417
(Contract FA-WH-4486)
(SRDS-65-31)

Factors affecting the acquisition and legibility of Airport Guidance Signs were studied to determine the optimum relationship between size, height and location of the signs. The studies showed the 500-foot minimum legibility requirement to be the predominant factor in size determination with a black letter on an illuminated field to be preferable from an acquisition viewpoint. A character size of 10 inches high by 8 inches wide was chosen as satisfactory for a distance of 500 feet. Author

N65-29342# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 196
12 Jul. 1965 60 p refs Transl. into ENGLISH of 12 articles from K'O-Hsueh T'ung-Pao (Peking), no. 4, Apr. 1965 p 339–361, 373–376
(JPRS-31032; TT-65-31530) CFSTI: $3.00
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7. ALL CHINA CONFERENCE ON SMELTING FURNACE HEAT TREATMENT PROCESSES H.- T. I p 50–51

N65-29372# George Washington Univ., Washington, D. C.
THE FUTURE OF THE NETWORK CONCEPT
Frederick M. Varney Apr. 1965 30 p refs
(PPSST3)

The networking concept represents an advance in the art of communicating in the planning of complex courses of action. It brings large numbers of people systematically into the operation of planning so that all, at every level, are able to take part and in that way enter the decision process itself. It is a vehicle for this participation, for decentralization of planning, for the illumination and the joint resolution of issues, and for the coordination of the diverse interests of people and organizations. This paper discusses the network concept, the process of networking, the background from which networking techniques developed, the present scope of network application, the network's contributions, and future applications of networking techniques. N.E.A.

N65-29430*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH AND DEVELOPMENT ECONOMICS
J. J. Phillips, Jr. [1964] 14 p refs Presented at Liquid Propulsion Symp., LPIA, Los Angeles, 23 Sep. 1964
(NASA-TM-X-51989) CFSTI: HC $1.00/MF $0.50 CSCL 05C

The future status of research and development, and its effect on the total economy is assessed. The impact of the cybernetic revolution, particularly in relation to clerical, middle management, design and service functions, and of technology advances on economic parameters and political thinking are also discussed. The rise in federal R & D expenditures since 1930 is tabulated, and a comparison made between federal and total expenditures. Expenditures for R & D by various government agencies are reviewed, and predictions made as to future trends. Foreign competition is discussed, and the role of American business in determining the course the economy will take is emphasized. M.G.J.

N65-29432*# National Academy of Sciences—National Research Council, Washington, D. C.
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION INTERNATIONAL UNIVERSITY FELLOWSHIPS IN SPACE SCIENCE Quarterly Report
30 Jun. 1964 13 p
(Contract NASr-62)
(NASA-CR-58853) CFSTI: HC $1.00/MF $0.50 CSCL 05I

Presented are data on current NASA supported fellowships in space science. Reported are fellowship terminations, transfers to other U.S. programs, extensions and renewals, and new fellowship applications. The University of Alabama was added as a participating university to accept applications for NASA International University Fellowships. The addition of the University will supplement the offerings of other institutions in the program in the following major fields: electromagnetics and space communications; high temperature thermodynamics and plasma technology; and gas dynamics and reentry hypersonics. Included is a report on the inspection visit to the University, both the main campus at Tuscaloosa and the Huntsville Center. Thirty-eight applications for one-year fellowships, to start in September 1964, were accepted by universities. The accepted applicants were from: Austria, Belgium, England, France, Germany, Italy, the Netherlands, Norway, Pakistan, Peru, Spain, Sweden, and Switzerland. S.C.W.

N65-29828# General Motors Corp., Indianapolis, Ind. Allison Div.
ALLISON RESEARCH AND ENGINEERING QUARTERLY, VOLUME NO. 6, 2ND QUARTER 1965
1965 34 p refs

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N65-29884# Congress. Senate. Committee on Aeronautical and Space Sciences.

UNITED STATES INTERNATIONAL SPACE PROGRAMS. TEXTS OF EXECUTIVE AGREEMENTS, MEMORANDA OF UNDERSTANDING, AND OTHER INTERNATIONAL ARRANGEMENTS, 1959–1965 Staff Report

Washington, GPO, 1965 555 p refs 89th Congr., 1st Sess., Doc. No. 44 GPO: $1.75

The worldwide scope of the United States' space efforts and the methods by which cooperation with other nations is achieved are revealed in a report prepared for the Senate Committee on Aeronautical and Space Sciences. The document, which is an official record of implementation of policy laid down by Congress in 1958, presents the texts of agreements relating to NASA tracking and data acquisition, experimental communications satellite testing, and cooperative projects; the Communications Satellite System (COMSAT); and the Smithsonian Institution Astrophysical Observatory. Both agreements between the United States and individual countries, and multilateral agreements are included. M.W.R.

N65-29949*# National Aeronautics and Space Administration, Washington, D. C.

DECISION-MAKING AND STATISTICAL STANDARDS

James E. Webb 28 Jul. 1965 20 p Presented at Natl. Governors' Conf., Minneapolis, 28 Jul. 1965 Available from the Scientific and Technical Information Division CSCL 05A

Methods and considerations necessary for sound decision making, and the use of statistical methods by state governments are discussed by James E. Webb, NASA Administrator. Changes which will help state and local governments in the areas of sophisticated use of advanced new information technology and administrative management are cited. The timely availability of accurate, comprehensive data, which is important to the effective conduct of state government, is stressed. C.T.C.

N65-29950*# Michigan State Univ., East Lansing.

SUMMARY REPORT ON THE NASA UNIVERSITY PROGRAM REVIEW CONFERENCE

Donald J. Montgomery Washington, NASA, 1965 42 p refs Conf. held Kansas City, Mo., 1–3 Mar. 1965 (NASA-SP-81) CFSTI: HC $1.00/MF $0.50 CSCL 05A

A summary is presented on a conference review of the NASA university program. The predoctoral training program, the sustaining university program research, project-type research including flight experiments and technology utilization, and research facilities are discussed. The conference showed NASA's growing maturity and vision in discharging its responsibilities in science. Universities participating in the predoctoral training program are appreciative of the authority to select candidates. The trainees have been well qualified. Other NASA training programs have met with enthusiasm and have evolved soundly and dynamically. NASA supported space-related university research has been impressive in its breadth and depth. Its project-type research in flight experiments has met with problems of complexity, reliability demands, and tight scheduling. Its technology utilization program has shown great potential to the community. NASA's support of university research by its multidisciplinary grants may be its most far-reaching contribution to itself and to the universities. R.N.A.

N65-30028*# National Aeronautics and Space Administration, Washington, D. C.

GUIDE TO THE SUBJECT INDEXES FOR SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

Jun. 1965 265 p (NASA-SP-7016, Rev. 2) CFSTI: HC $2.75/MF $1.50 CSCL 05B

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N65-29792 # 18-05 ..... AM-65-15
N65-29793 # 18-11 ..... PG-11/CA/

N65-29794 # 18-16 ..... TEAM-276
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N65-29796 # 18-22 ..... STL-372-13
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N65-29821*# 18-17 ..... NASA-CR-268
N65-29822*# 18-28 ..... NASA-CR-269
N65-29823*# 18-09 ..... NASA-CR-54447
N65-29824*# 18-03 ..... NASA-CR-54450
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N65-29846*# 18-07 ..... NASA-SP-7022/02/
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N65-29848*# 18-14 ..... NASA-TM-X-55259
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N65-29856 # 18-24 ..... EUR-2412.E
N65-29857 # 18-22 ..... ANL-6996
N65-29858 # 18-12 ..... D1-82-0445
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N65-29864 # 18-08 ..... NO REPORT NUMBER
N65-29865 # 18-02 ..... AD-427014
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N65-29867 # 18-24 ..... WL-TR-64-172
N65-29868 # 18-30 ..... FTD-TT-64-1361/1
N65-29869 # 18-07 ..... REPT.-54-F-2
N65-29870 # 18-17 ..... IITRI-B183B2-8
N65-29871 # 18-10 ..... HDL-TM-65-19
N65-29872 # 18-18 ..... ML-TDR-64-19, PT. II
N65-29873 # 18-07 ..... REPT.-2985
N65-29874*# 18-14 ..... NASA-CR-54439
N65-29875 # 18-12 ..... NO REPORT NUMBER
N65-29876 # 18-14 ..... WRE-TN-ISD-57
N65-29877 # 18-33 ..... EUR-2281.F
N65-29878 # 18-20 ..... NO REPORT NUMBER
N65-29879 # 18-04 ..... JPRS-31349
N65-29880 # 18-13 ..... JPRS-31397
N65-29881 # 18-12 ..... NO REPORT NUMBER
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N65-29907 # 18-01 ..... DTMB-2005
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N65-29921 # 18-09 ..... TR-65-3
N65-29922 # 18-32 ..... USAAML-TR-65-5, PHASE III
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N65-29953*# 18-01 ..... NASA-TM-X-1118
N65-29954*# 18-06 ..... NASA-TT-F-379
N66-29955*# 18-07 ..... NASA-TM-X-55278
N65-29956*# 18-13 ..... NASA-TM-X-55238
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N65-29976 # 18-24 ..... AAEC-E-119
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N65-30004 # 18-27 ..... FTD-TT-65-62/1
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N65-30006 # 18-14 ..... FTD-TT-65-205/1+2
N65-30007 # 18-14 ..... AD-616396
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N65-30009 # 18-12 ..... ARL-65-67
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N65-30034 # 18-33 ..... REPT.-25165
N65-30035 # 18-01 ..... ASRL-TR-117-1
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N65-30042 # 18-09 ..... REPT.-5
N65-30043 # 18-09 ..... RADC-TR-65-5
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N65-30056 # 18-24 ..... TID-21830
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N65-30057 # 18-06 ..... SM-RI-6663

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N65-30106 # 18-26 ..... RSIC-400
N65-30107 # 18-14 ..... RADC-TDR-64-405
N65-30108 # 18-14 ..... RADC-TR-65-47
N65-30109 # 18-09 ..... QPR-3
N65-30110 # 18-14 ..... AFCRL-65-382
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N65-30112 # 18-06 ..... FTD-TT-64-1151/1
N65-30113 # 18-32 ..... AMRA-TR-65-08
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N65-30120 # 18-03 ..... R-5405-7
N65-30121 # 18-07 ..... RADC-TR-65-108
N65-30122 # 18-07 ..... RADC-TR-65-114
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N65-30152 # 18-09 ..... REPT.-6
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N65-30154 # 18-01 ..... KN-65-699/FR/
N65-30155 # 18-09 ..... REPT.-7
N65-30156 # 18-05 ..... AMRL-TR-65-18
N65-30157 # 18-09 ..... REPT.-3115A-65
N65-30158 # 18-07 ..... AFCRL-65-322
N65-30159 # 18-16 ..... AD-617342
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N65-30162 # 18-08 ..... ESD-TR-65-276
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N65-30174 # 18-06 ..... ORNL-P-925
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N65-30177 # 18-24 ..... NP-TR-1206
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N65-30179 # 18-26 ..... LA-TR-64-34
N65-30180 # 18-24 ..... HUX-2752-1
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